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Love, Learn, Protect: Assessing the short-term impact of Lisbon Zoo school education programs on 10-18 years old students

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*"A magia do Jardim Zoológico, crianças nos Estados Unidos veem um Rinoceronte-*indiano *pela primeira vez através de um Programa por Skype"*

Por Beatriz Pequeno, Jardim Zoológico – Janeiro de 2020

"In the end, we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught." – Baba Dioum

Preliminary Note

This study, integrated in Lisbon Zoo Education Strategy assessment, resulted in one oral communication and one poster, to be presented at the following congresses:

- International Zoo Educators Association 25^{th} Bi-annual Conference, 10^{th}-11^{th} October 2020 (oral communication)
- XIV Congresso Luso-Afro-Brasileiro e 3º Congresso da Associação Internacional de Ciências Sociais e Humanas de Língua Portuguesa, 15^{th}-17^{th} September 2021 (poster presentation).

Resumo Alargado

A população humana está cada vez mais a migrar para cidades, sendo estimado que, em 2050, cerca de 68% da população mundial se encontre concentrada em zonas urbanas. Com a crescente urbanização, a dissociação entre os humanos e a natureza torna-se, cada vez mais, um fator de ameaça à Biodiversidade, visto que, pessoas que têm reduzido contacto com natureza, não desenvolvem sentimentos de apreço para com esta. Por sua vez, esta falta de apreço leva a uma menor consciência ambiental e envolvimento em comportamentos pró-conservação.

Perante este contexto, os Zoos modernos são considerados locais privilegiados, com a responsabilidade de criar pontes entre os humanos e a natureza. As instituições pertencentes às Associações Mundial e Europeia de Zoos e Aquários têm como principais missões assegurar o bem-estar animal e promover a investigação científica, a conservação e a educação ambiental.

Uma destas instituições é o Jardim Zoológico, uma instituição de utilidade pública atualmente localizada em Sete Rios, Lisboa. O seu Centro Pedagógico é responsável por promover várias ações de educação ambiental dentro e fora do Jardim Zoológico, de entre as quais, mais de 30 Programas Educativos Escolares gratuitos. Todos estes Programas possuem uma forte ligação com o currículo formal das escolas, sendo por isso reconhecidos como de Utilidade Educativa pelo Ministério da Educação. Além disso, são baseados nos três domínios da Educação Ambiental: Emocional, Cognitivo e Comportamental, pois assentam na premissa de que, se as crianças se apaixonarem pela natureza irão querer aprender mais sobre esta e, ao aprenderem mais, mais facilmente irão querer protegê-la (estratégia Amar, Conhecer, Proteger). No entanto, embora já tenham sido realizadas avaliações internas específicas a alguns objetivos, os Programas ainda não foram alvo de uma avaliação profunda e integrada de todos os seus domínios.

Este estudo teve como principal objetivo avaliar o impacto a curto prazo dos Programas Educativos Escolares do Jardim Zoológico, em alunos entre os 10 e os 18 anos. Especificamente, pretendeu-se medir os efeitos dos Programas nos domínios Emocional, Cognitivo e Comportamental dos alunos e, adicionalmente, compreender como é que estes domínios interagem entre si.

Para tal, foram aplicados questionários pré-pós Programa, às turmas que participaram em três dos Programas Educativos Escolares do Jardim Zoológico, tendo sido adaptados às três faixas etárias correspondentes (10-12, 12-15 e 15-18 anos). O mesmo questionário (modelo pré-Programa) foi também aplicado a turmas independentes, que não visitaram o Jardim Zoológico no correspondente ano letivo, de forma a garantir um grupo de controlo. Os questionários permitiram a recolha de dados quantitativos e qualitativos representantes dos três domínios, assim como de informação demográfica dos alunos. Posteriormente, foram realizadas comparações controlo-pré e pré-pós-Programa para todos os objetivos específicos (i.e. questões individuais) e para cada domínio de forma integral, recorrendo a índices criados para o efeito.

No total, foram recolhidos 300 questionários por cada faixa etária que participou nos Programas (exceto para o grupo dos 12-15 anos, onde se recolheram 217) e 200 por cada faixa etária do grupo de controlo. Em algumas perguntas, e mesmo domínios, certas idades do grupo de controlo apresentaram diferenças em relação aos pré-Programas dos alunos visitantes. Os alunos dos 10-12 anos demonstraram valores significativamente inferiores nos domínios Cognitivo e Comportamental relativamente aos alunos à chegada do Jardim Zoológico. Já os alunos entre os 15-18 anos revelaram índices de domínios Emocional e Cognitivo significativamente maiores que os alunos que visitaram o Jardim Zoológico (pré).

Todos os Programas Educativos Escolares avaliados manifestaram um efeito positivo significativo nos três domínios dos alunos que visitaram o Jardim Zoológico. No entanto, alguns objetivos específicos, nomeadamente os que dizem respeito à preocupação para com a natureza, conhecimento sobre ecossistemas ou sobre evolução, preocupação relativamente a plantas e conhecimento de boas práticas ambientais, não foram atingidos em algumas faixas etárias. Relativamente à interação entre domínios, observou-se uma relação positiva entre os domínios Emocional e Comportamental das faixas etárias mais novas (10-12 e 12-15 anos), e entre os domínios Cognitivo e Comportamental dos alunos mais velhos.

Aponta-se como possível justificação dos resultados referentes ao grupo de controlo, diferenças nalgumas variáveis sociodemográficas individuais, que não foram possíveis recolher, entre as quais o acesso/não acesso a espaços verdes, educação e área de empregabilidade dos pais, entre outras. Adicionalmente, a preparação da visita por parte dos Professores visitantes, ou a diferença de ambientes aquando do preenchimento dos questionários, podem também ser considerados fatores explicativos. Ainda assim, tendo em conta estas possibilidades e constrangimentos, foi possível assumir os dados do presente estudo como representativos da população escolar em geral.

Já as descobertas relativas aos objetivos específicos em que não se verificou um aumento, estas podem dever-se essencialmente a dois fatores. Um dele é o "efeito teto", ou seja, a escolha pelos alunos do nível mais alto possível nos pré-questionários. O outro é relativo à menor experiência que os Educadores do Jardim Zoológico poderão apresentar relativamente à abordagem de algumas temáticas, devido a serem recentes nos Programas, ou de certas idades, devido à menor frequência nos mesmos.

Entrando nos resultados referentes ao impacto positivo que os Programas Educativos Escolares do Jardim Zoológico tiveram nos três domínios dos alunos, estes poderão ser explicados pelas experiências enriquecedores do ponto de vista de desenvolvimento que estes Programas representam. Do ponto de vista Emocional, é possível que os encontros próximos com as espécies e os seus comportamentos naturais tenha suscitado nos alunos sentimentos de empatia e ligação para com estas. Relativamente ao Conhecimento, estas descobertas poderão dever-se à forte ligação com o currículo escolar e à educação centrada nos alunos que os Programas apresentam. Estes dois fatores, juntamente com o auxílio de observar as espécies, contribuíram para que os alunos conseguissem conceptualizar matérias previamente teóricas. Finalmente, o domínio Comportamental dos alunos provavelmente foi beneficiado, do ponto de vista de compreensão sobre a conservação e vontade de participar na mesma, devido à estratégia de mudança comportamental que os Programas seguem. Ao oferecer soluções específicas para ameaças igualmente específicas, recorrendo às experiências prévias dos alunos através de uma abordagem interpretativa adaptadas a cada faixa etária, esta estratégia conseguiu fomentar nos alunos um sentimento de confiança e responsabilidade em relação ao seu próprio comportamento.

Por último, a diferente associação encontrada entre os domínios nas várias faixas etárias poderá ser resultado de diferenças nos estádios de desenvolvimento dos alunos. Alunos mais novos têm como base de mudanças comportamental a conexão e preocupação que estabelecem para com a natureza (Emoção). Enquanto alunos mais velhos, que provavelmente já tiveram mais experiências prévias para com esta, são estimulados a desenvolver comportamentos pró-conservação quando o seu interesse é despertado através de novo conhecimento sobre o assunto (Conhecimento). Dai que seja extremamente importante incluir os três domínios, de forma adequada para cada faixa etária, na realização de Programas de Educação Zoológicos bem-sucedidos.

Este estudo constitui a primeira avaliação científica em larga escala dos Programas Educativos Escolares do Jardim Zoológico. Como tal, irá ser crucial para o desenvolvimento e implementação de melhorias em futuros Programas. Adicionalmente, a mesma metodologia poderá ser aplicada na avaliação dos mais de 50 Programas pelos quais o Centro Pedagógico é responsável, apoiando assim a sua Estratégia Educativa.

Concluindo, de forma a melhorar a educação em Zoos, estimulando a conexão dos alunos com a natureza e, consequentemente levar a mudanças comportamentais positivas para o ambiente, sugere-se que a estratégia ACP (Amar, Conhecer, Proteger) empregue no Jardim Zoológico deverá ser considerada.

Palavras-chave: Educação Ambiental; Conservação; Comportamento pró-ambiental; Mudança comportamental; Interação humano-animal

Abstract

At a time where populations are increasingly migrating to cities, Zoos are considered privileged locations, with the responsibility of creating bridges with the natural world. With millions of visitors every year, Zoos have a large audience that can be inspired into protecting wildlife. In order to achieve this mission, Lisbon Zoo delivers more than 30 School Education Programs, adjusted to students' school curriculum, which represent a unique conservation engagement opportunity. As research has recently shown that people with deep emotional connections and more educated towards nature have stronger interest in its conservation, Lisbon Zoo Programs have at their core the three domains of environmental education: Emotional, Cognitive and Behavioural. Although smaller target evaluations have been internally conducted, the Programs have not yet been subject to an integrated in-depth impact assessment. The main goal of this study was to assess the short-term impact of Lisbon Zoo School Education Programs, by measuring the effect of three Programs on 10-18 years old students' Emotion, Knowledge and Behaviour domains. Moreover, we aimed to understand how these domains interact with each other. We used a control-treatment design, with pre-post Program questionnaires that gathered both quantitative and qualitative data on students' domains. All Programs revealed a positive cumulative influence on the three domains. Nonetheless, some specific outcomes, namely nature awareness, knowledge about ecosystems and evolution, concern about plants, and the ability to name useful pro-conservation actions, were not reached in all age groups. Regarding domains' interaction, we found a positive relation between Emotion and Behaviour in 10-12 and 12-15 years old students and between Knowledge and Behaviour in 15-18 years old's. These findings will be crucial in future development and implementation of Programs at Lisbon Zoo, supporting its Education Strategy of Educating for nature Conservation. Furthermore, they highlight the value of incorporating Emotion, Knowledge and Behaviour in successful behaviour change education at Zoos, suggesting that a Love, Learn, Protect approach leads to positive conservational outcomes.

Keywords: Environmental Education; Conservation; Pro-environmental behaviour; Behaviour change; Human-animal interactions

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List of Abbreviations

EAZA – European Association of Zoos and Aquariums

IUCN – International Union for Conservation of Nature

LZ-SEP – Lisbon Zoo School Education Programs

TPB – Theory of Planned Behaviour

WAZA – World Association of Zoos and Aquariums

y.o. – years-old

Introduction

By 2050, it is estimated that around 68% of the World population will be living in urban areas, deprived of strong nature connections (United Nations, 2018; Turner et al., 2004). The progressive loss of environmental connections with nature, known as the “extinction of experience”, and its consequences, have being increasingly studied (Soga et al., 2016). Such consequences, not only involve human well-being and mental health costs, but also, direct damaging impacts in nature, that are recognised as the main driver to the current biodiversity loss crisis (Mace et al., 2008; Millennium Ecosystem Assessment (MEA), 2005; Soga et al., 2016). In fact, the dissociation of humans from nature possibly represents the most silent and universal threat of all, since those who do not experience and interact with nature are less likely to establish appreciation towards the environment, to place importance in its conservation or to engage in pro-environmental behaviour (Collado et al., 2015; Loyau and Schmeller, 2017). In this current nature displacement scenario, how can we reconnect humans with nature and mitigate future sequels on conservation? We bring nature to humans (Loyau and Schmeller, 2017).

In this context, today´s accredited Zoos are privileged locations, with the responsibility of building bridges between humans and the natural world, especially at urban areas (Falk et al., 2007.; Mellish et al., 2019). The affiliated Zoos of the Word Association of Zoos and Aquariums (WAZA) and the European Association of Zoos and Aquariums (EAZA) undertake animal care and welfare, scientific research, conservation, and environmental education as their priorities (Barongi et al., 2015; EAZA, 2017). The uniqueness of conservation education that Zoos offer (Tofield et al., 2003), resides in the sense that children are not only encouraged to experience nature first-hand, but to learn about biodiversity and how to conserve it through active engagement (Tofield et al., 2003; Maynard et al., 2020). Studies show that when children and adolescents have rewarding experiences in Zoos (involving wildlife observations and encounters), their awareness, appreciation towards nature and willingness to engage in sustainable behaviours are enhanced (Grajal et al., 2017; Mann et al., 2018). Given that this empathy and behaviours through involvement tend to be carried into adult life, Zoos can be set in the forefront of conservation education worldwide (Barongi et al., 2015; Maynard et al., 2020).

One of the founder members of EAZA and member of WAZA is Lisbon Zoo, an institution of public utility, founded in 1884, currently located at Sete Rios, Lisbon. The foundation of the Educational Department in 1996, trailed the Zoo’s mission of facilitating human-nature connections and promote an effective strategy for conservation education (Centro Pedagógico, 2011). Environmental education gained relevance and the Zoo now offers more than 30 different, free, School Education Programs. These Programs are age-appropriate, from Preschool to Higher Education, adapted to students’ school curriculum and approved by the Portuguese Education Ministry (Centro Pedagógico, 2011). Such poses a unique opportunity, since most Zoos’ programs are not frequently adjusted to school curricula, which has been suggested to hinder students’ learning on biology and conservation (Randler et al., 2012). Furthermore, the Programs are delivered by trained Zoo Educators, which has been shown to, not only improve emotional, knowledge and behavioural outcomes, but having long-lasting effects (Collins et al., 2020; Jensen, 2014). Each program has its own standardized and mandatory contents. Additionally, the Educators receive team training, three times a year, to standardize Programs and team goals, allowing a more coherent Education Strategy. This strategy has at its core the three main domains of conservation education: Emotional, Cognitive and Behavioural (EAZA, 2017; Jacobson et al., 2015).

The Emotional domain is often considered the first driver of an effective Education Strategy for conservation, given that, positive feelings of connection, empathy and respect towards nature, lead to increase environmental awareness and engagement (Littledyke, 2008; Zhang et al., 2014). It is extremely difficult to assess, given that human emotions have intricate personal meaning that is dependent of individual psychological, physiological and sociodemographic elements (Castillo-Huitrón et al., 2020). In the particular case of Zoos, these feelings are facilitated by the hands-on experiences that such stimulating settings provide (Clayton et al., 2009; Jensen, 2014). The experiences involve close encounter with wild animals that are, otherwise, extremely difficult, especially at urban areas, which, in turn, can trigger great admiration and concern towards them (Powell and Bullock, 2014; Dohn et al., 2013). Nevertheless, different species have different potentials for the arousal of such positive emotions, being wildly recognised the importance of charismatic, flagship species on human conservation engagement (Carr, 2016; Moss and Esson, 2010). As human emotions endure through time, this affinity is a considered a key element on the decision-making process of some conservation issues (Saunders, 2003). Therefore, it is extremely important to study how Zoos may improve these positive emotions regarding wildlife, and decrease negative ones, in order to reach positive conservation outcomes (Castillo-Huitrón et al., 2020).

Unlike Emotion or Behaviour, children's Knowledge (Cognitive domain) is a well-studied field, when it comes to Zoos education assessments all over the World (Collins et al., 2020; Jensen, 2014; Randler et al., 2012). These studies, among others, mirror conservation psychologist's identification of learning goals has a key component for engaging in pro-conservation behavioural change (Saunders, 2003). Furthermore, they have highlighted the value that effective Zoo education programs can have on students' short-term biology learning (Collins et al., 2020; Jensen, 2014; Randler et al., 2012). When these programs have structured goals, following modern aspects of teaching and learning, Sørensen and Kofoed (2003) classify them as "learning resources tours", as they are proven to facilitate their participants learning process. Jensen (2014) and Randler et al. (2012) found that students who participate in educational interventions or use education resources offered by Zoos, usually achieve greater learning outcomes than those visiting the Zoo in an unstructured, informal context. Moreover, the importance of experiences with Zoo animals' behaviours and surroundings are again emphasized for this domain, as knowledge acquisition is greatly enabled through direct observation and practical activities (Collins et al. 2020, Randler et al., 2012).

Finally, the relevance of studying Behaviour lies on the concept that environmental conservation is only possible when the society is actively involved in it (Saunders, 2003). When studying this domain, it is essential to look, not only at peoples' intention for engaging in pro-conservation behaviours, but also at their understanding on the topic, since one should not expect for people to change their habits when they are completely unaware of their negative impact (Bueddefeld Van Winkle, 2017; Zhang et al., 2014). Furthermore, according to the Theory of Planned Behaviour (TPB) (Ajzen 1991), people´s behaviours are highly associated with their intentions and perceptions of their personal confidence on the ability to perform the target behaviour (Mann et al., 2018). Even so, we must stress that, of the three domains, Behaviour is the most difficult to measure. Actual behavioural change is very challenging to measure, as students self-reported intentions towards conservation may not be translated into real-life future behavioural changes (Bueddefeld Van Winkle, 2017; Jensen et al., 2017). Nonetheless, student's conservation understanding and perceived behaviours, can serve as good predictors (Collins et al., 2020). These provide students with the tools to reflect and search for further engagement and information, which frequently leads to lasting behavioural outcomes (Collins et al., 2020; Mann et al., 2018). Behavioural outcomes can be stimulated in Zoos where visitors develop the ability to recognise that a conservation problem exists, and to make conceptual links between those threats and their own behaviour (Grajal et al., 2017). However, for successful behavioural change strategies assessment, the influence of Emotion and Knowledge should be considered (Littledyke, 2008) as cognitive research has recently shown that people with deep emotional connections and more educated towards nature have stronger interest in its conservation (Grajal et al., 2017; Littledyke, 2008).

To achieve these educational outcomes, Zoos have progressively focused their aim towards assessing their educational program offers (Mellish et al., 2019; Sattler and Bogner, 2017). However, until quite recently, conservation education was rarely studied outside school environments (Mast et al., 2018). As a result, the first instruments for data collection on Zoo education were adapted from evaluation instruments for school settings, and only recently have tools on specific Zoo and Education Programs been developed (Mast et al., 2018). Commonly, this tool is a matching pre-post-test visit written questionnaire (77.1% of times, according to Mellish et al. (2019)), particularly with adults and children age seven or above (Bell, 2007). Drawings (for young children) and interviews are considerably more time and resource consuming alternatives, which institutions frequently lack, as well as more subjective to the researcher interpretation (Mast et al., 2018; Mellish et al., 2019). Also, questionnaires allow researchers to collect, at once, both quantitative and qualitative (e.g. thematic analysis) data, granting a more in-depth overview of the questions evaluated (Roe and McConney, 2015).

In an effort to improve future Zoo education research, Mellish et al., (2019) reported multiple factors to be considered when developing these studies, that we aimed to achieve. According to the authors, most studies (79.2%) do not perform any pilot trials, (thus lacking validation), do not employ any qualitative data measures (50.0%) or, when they do, tend to analyse it with quantitative methods, thus losing the insight that this data can provide. (Mellish et al., 2019). Moreover, most studies solely assess Knowledge a measure of educational success (Randler et al., 2012; Sattler and Bogner, 2017). But perhaps more striking, is that few Zoo research was ever conducted on children attending field-trips, revealing a challenging gap, given that school students represent the main target audience of Zoo education programs(Counsell et al., 2020; Mast et al., 2018).

In particular, Lisbon Zoo welcomes 75.000 students every year, representing a vast audience that can be engaged and inspired into protecting wildlife. Nevertheless, Lisbon Zoo School Education Programs (LZ-SEPs) have not yet been subject to an integrated in-depth assessment, even though smaller target evaluations have been internally conducted. Lisbon Zoo Educational Department acknowledges this opportunity and perceives environmental education research as the next step towards effective development and improvement of pro-conservation programs. This represents the first-ever, large scale, scientific, assessment of LZ-SEPs short-term contribution to conservation.

Study aims

Our main aim was to assess the short-term impact of LZ-SEPs on 10 to 18 years old (y.o.) students. We specifically aimed to (1) measure the effect that an Education Program has on the three domains of environmental education; and (2) how these domains interact with each other.

To fulfil these goals, we formulated several hypotheses, tested in this research:

(1) A LZ-SEP increases students' empathy and concern towards nature and the Zoo;
(2) A LZ-SEP increases students' knowledge about biology;
(3) A LZ-SEP has a positive influence on students' awareness and intended behaviours regarding nature conservation;
(4) Emotion and Knowledge have positive influence on students' awareness and intended behaviours towards nature.

Methods

Lisbon Zoo School Education Programs (LZ-SEPs)

We focused on three different LZ-SEPs from the Educational Center, each adapted to an age group, “Adaptations and Behaviours” (10-12 y.o.), “Discovering Ecosystems” (12-15 y.o.) and “Darwin´s Route” (15-18 y.o.), accordingly to the Portuguese school cycles (*Lei nº 46/86, 14 de Outubro 1986*). All programs were delivered by a single Zoo Educator, had a duration of 90 minutes, and included an introduction (~15 minutes), an interpretative tour through the Zoo (~ 60 minutes) and an evaluation of the learnt contents (~15 minutes).

The introduction was common to all programs, with an overview to Zoo´s history, missions and rules, and a summary on the program´s theme. During the guided tour, each Zoo Educator was free to define the itinerary, the only requirements being to stop and talk about a minimum of 14 different species, of which, at least, two must be Plants, two Birds and one Reptile or Amphibian. The Programs contents at this stage were mandatory and presented below, but each Educator was free in the selection of species, way and order that approaches each topic and to add species and Zoo management information.

Program Adaptations and Behaviours

By the end of the Program, students should have been able to: recognise animal and plant´s adaptation related to the habitat; understand the function and importance of animal´s body covering; identify features and adaptations related to animal´s locomotion; compare animal´s diet and respective adaptations to it; distinguish “sexual dimorphism” concerning male and female roles; associate reproduction with behavioural changes; associate environmental factors with behavioural change (Centro Pedagógico, 2013a).

Program Discovering Ecosystems

After the LZ-SEP, students were expected to: name and describe different habitats where Zoo´s species live in; recognise the influence that abiotic factors have on the behaviour and physiology of animals; recognise the main ecosystem services and exemplify with Zoo´s species; differentiate diets and reproductions strategies as means of ecosystem adaptation; identify the different trophic levels and examine species trophic roles in the ecosystem; identify and exemplify intra and inter-specific biotic interactions; differentiate sex in some animal groups according to species morphological characteristics and comprehend their influence in biotic interactions; characterize some taxonomical groups present at Lisbon Zoo; (Centro Pedagógico, 2013b).

Program Darwin’s Route

At the end of the Program, students should have been able to: understand the importance of the Binomial Nomenclature and how it was constructed; understand the concept of “Evolution”; differentiate Evolutionary from Creationist and Catastrophic Theories; identify the laws behind Lamarck and Darwin’s Evolutionary Theories and their differences; recall some of Darwin’s history, his voyage in the Beagle, along with some of his most significant discoveries in the Galapagos islands; differentiate between artificial and natural selection; relate convergent and divergent evolution with homologous and analogous features; interpret phylogenetic trees and understand their importance. This was the only of the assessed programs where Zoo Educators had required stops: one species whose genus was described by Carl Linnaeus, one of the phylogenetic trees existing in the Zoo and three plants (Centro Pedagógico, 2013c).

Common to the three LZ-SEPs

After LZ-SEPs students should have been able to: explain the concept of “threatened species” and exemplify the main threats to species extinction; relate the main threats to both animals and plants with the human overexploitation of natural resources; comprehend the role of modern Zoo´s, Lisbon Zoo in particular, in species research, conservation and public education; recognise the importance of environmental enrichment for wild animals, exemplifying the five types of environmental enrichment proper for each animal group and determine good environmental practices students can use in their day-to-day life.

In the final stage of all programs, student’s short-term learning outcomes were assessed through a variety of methodologies, chosen by the Educator, that range from quick memory card games, animal charades or the construction of an animated trophic web (for 12-15 y.o.). The Darwin´s Route program was the only one where the evaluation is predetermined: students were encouraged to carry out a debate about the Creationist and Evolutionary Theories, applying Zoo´s species and learnt contents as arguments, with the Zoo Educator as mediator.

Survey Instrument development and validation

We aimed at assessing students’ learnings and perspectives before and after an LZ-SEP, therefore the survey consisted of one pre- and one post-Education Program written questionnaire. Three separate questionnaire forms were built, adapted to the different students’ ages and LZ-SEPs.

We assembled the questionnaire, according to Lisbon Zoo Education Strategy, in three distinct domains: Emotion, Cognitive and Behaviour. According to the LZ-SEPs, and considering different questionnaires from other Zoos (Balmford et al., 2005; Bell, 2007; Davidson et al., 2010; Falk et al., 2007.; Kruse and Card, 2004), we elaborated a variety of questions for each domain, both quantitative and qualitative (Tab. 1.1). Types of questions varied in measurement techniques, including five point Likert-scales (“Completely Agree” to “Completely Disagree”), binomial (“Yes”/”No”), multiple response and open-ended questions (all with a complementary “Don’t know/Don’t answer” option). This range of measurements provide a broader assessment, combining data simple to analyse with the insight of information that open questions can deliver (Roe and McConney, 2015; Taherdoost, 2016).

The questionnaires were analysed by a panel of specialists from Lisbon Zoo Educational Team, who helped us assemble two different versions of age-appropriate preliminary pre- and post-questionnaires, with around 14 questions. The questionnaires differed in question formulation, Likert and binomial-scale order, number of options in multiple choice questions and extension of answers required in open questions (Bell, 2007; Taherdoost, 2016).

During the 2019 Summer Zoo Camp, we conducted a one-week pilot experiment using the two versions of questionnaires prototypes, with a group of around 124 students (50 of 10-12 and 12-15 y.o. and 24 of 15-18 y.o.). Within all age-groups, each half received one of the versions, at the beginning of the week, to avoid exposure bias. Questionnaires were validated with a data-collection approach as this can provide evidence of whether items cause problems (Marsden and Wright, 2010).

After this validation stage we revised all issues that caused any confusion, for all ages, and shortened questions for the 10-12 y.o.

At the end, we had a complete pre- and post-questionnaire, with 16 questions (three demographical, four Emotional, three Cognitive and six Behavioural) for each age group (Tab. 1.1), englobing the subsequent domains:

Demographic Information

We had an a priori knowledge of students' age group (relating to their school cycle LZ-SEPs appointment). To complement their demographic data, we collected their county origin information and asked if they had been to Lisbon Zoo before, which can largely influence their background knowledge (Balmford et al., 2005) (Tab. 1.1).

Emotional Domain (empathy and concern towards nature and the Zoo)

To assess how students' expectations and perspectives of the Zoo may influence their learnings and future behavioural changes (Powell and Bullock, 2014), we asked them to rank their expectations about visiting the Zoo, and to choose the purposes of a Zoo. We then asked them to rate their level of concern towards the Planet, animals, and plants. Finally they were requested to name their favourite species at Lisbon Zoo and why, since species physical and behavioural characteristics are proved to have a direct role in students and visitors emotional connections towards animals (Powell and Bullock, 2014; Skibins et al., 2017). These questions were common to all age groups (Tab. 1.1).

Cognitive Domain (knowledge about biology)

To investigate students' knowledge gain (Tofield et al., 2003; Jacobson et al. 2015) we elaborated three different questions adapted to each age group. For the 10-12 y.o., we evaluated their knowledge of animal classes (assessed through Reptile´s class characteristics, the most unfamiliar class to young children), their understanding of animal´s behaviours and adaptations (we used the Great White Pelican as model, since the different types of feathers, interdigital membranes or feather permeability are mandatory school curriculums which they should be familiar prior to Zoo´s visit) and animals locomotion knowledge (using Birds as model).

In the 12-15 y.o. groups, we assessed students' understanding of ecosystems (using Tropical Forest as model, knowledge of biotic interactions (through matching "Parasitism", "Predation", "Cooperation", "Mutualism", "Competition" and "Symbiosis" with a selection of animal-pairs) and their understanding of trophic webs relations.

Finally, for 15-18 y.o. students, we estimated their grasp on evolutionary features, Homology vs Analogy (using Penguins flippers and Macaws wings as example), their knowledge on Evolution and the role of Pangea, and the comprehension of Darwinism Theory and its drivers of evolution. These different questions enabled us to have an overall understanding of their knowledge about nature at arrival and potential gain with the LZ-SEP (Davidson et al., 2010; Falk et al., 2007; Tofield et al., 2003) (Tab. 1.1).

Behavioural Domain (awareness and behaviours regarding nature conservation)

For the last part of the questionnaire, we aimed to assess students' conservation understanding and predisposition for behavioural change at a short-term perspective, therefore, we assembled a series of questions common to all age groups. We began by inquiring students regarding plants' importance in the natural world, since engagement with plants can lead to the care and appreciation for plants in the future (Jacobson et al. 2015, (Littledyke, 2008). To complement this approach, we also asked their opinion regarding if animal conservation was more important than plant conservation. Secondly, we evaluated students' perspectives towards Zoos' role in conservation, since pre-existing experiences regarding Zoos (Lisbon or others) may have a direct impact in behaviour towards nature conservation (Falk et al., 2008; Roe and McConney, 2015). Then, we asked students if they could name any threatened species and, for two older groups, at least one threat to species' survival. Finally, their attitudes towards nature conservation were assessed (if they believed that they could help protect the Planet) and students were requested to name a way they could achieve this protection. These questions allowed us to assess the contribution of LZ-SEPs in promoting students' pro-ecological behaviour (Balmford et al., 2005). (Tab. 1.1).

The questions were common to the pre- and post- questionnaire and the estimated response duration was 15 minutes for each part.

Table 1.1 - Questionnaire items for each domain and age group. Item scaling type between parentheses.

	Ages 10-12	**Ages 12-15**	**Ages 15-18**
Emotional Domain			
Q.1 *[1]	I hope to enjoy/enjoyed the visit at the Zoo (5 point Likert-scale)	I hope to enjoy/enjoyed the visit at the Zoo (5 point Likert-scale)	I hope to enjoy/enjoyed the visit at the Zoo (5 point Likert-scale)
Q.2	I care about the planet, animals and plants that live in it (5 point Likert-scale)	I care about the planet, animals and plants that live in it (5 point Likert-scale)	I care about the planet, animals and plants that live in it (5 point Likert-scale)
Q.3	For me, Zoos are for... (Multiple choice)	For me, Zoos are for... (Multiple choice)	For me, Zoos are for... (Multiple choice)
Q.4	What will it be/was your favourite animal at the Zoo? Why? (Open-ended)	What will it be/was your favourite animal at the Zoo? Why? (Open-ended)	What will it be/was your favourite animal at the Zoo? Why? (Open-ended)
Cognitive Domain			
Q.5	Chose the characteristics of a Reptile. (Multiple choice)	Chose the element´s that are part of a Tropical Forest ecosystem. (Multiple choice)	According to Evolutionism, Penguin flippers and Macaw wings are examples of… (Multiple choice)
Q.6	Think about the Great White Pelican, name to behaviours and/or adaptations important for its life type, feeding or habitat. (Open-ended)	Make the connection between living organisms and the biotic interactions between them. (Matching)	Geographically, how do you explain the origin of so many different species from a common ancestor? (Open-ended)
Q.7	Regarding their locomotion type, all Birds can Fly. (Binomial, "Yes/No")	In a simple trophic web, with Plants, Herbivores and Carnivores, if Carnivores become extinct, the number of Herbivores will increase endlessly. (Binomial, "Yes/No")	According to Darwin´s Theory, natural selection is the only vector of evolution. (Binomial, "Yes/No")

Table 1.1 - (Continued)

Behavioural Domain			
Q.8	Plants are important for our planet because… (Multiple choice)	For you, why are plants important for us and the planet in general? (Open-ended)	For you, why are plants important for us and the planet in general? (Open-ended)
Q.9	For you, is more important to protect animals first and, only later, plants. 5 point Likert-scale)	For you, we should prioritize animal species´ conservation and, only later, plant species´ conservation. (5 point Likert-scale)	For you, we should prioritize animal species´ conservation and, only later, plant species´ conservation. (5 point Likert-scale)
Q.10. 1	Name one threatened animal. (Open-ended)	Name one threatened species. (Open-ended)	Name one threatened species. (Open-ended)
Q.10.2 *[2]	-	Why is that species threatened? (Open-ended)	Why is that species threatened? (Open-ended)
Q.11	For you, Lisbon Zoo is important in avoiding threatened animals disappearance (5 point Likert-scale)	For you, Lisbon Zoo is important in avoiding threatened species extinction (5 point Likert-scale)	For you, Lisbon Zoo is important in avoiding threatened species extinction (5 point Likert-scale)
Q. 12	There is something you can do to help protect the planet and its threatened animals. (5 point Likert-scale)	There is something you can do to help preserve the planet and its threatened species. (5 point Likert-scale)	There is something you can do to help preserve the planet and its threatened species. (5 point Likert-scale)
Q. 13	If you answered “Agree” or “Completely agree”, name one useful action you can do to help protect the planet and its threatened animals. (Open-ended)	If you answered “Agree” or “Completely agree”, name one useful action you can do to help preserve the planet and its threatened species. (Open-ended)	If you answered “Agree” or “Completely agree”, name one useful action you can do to help preserve the planet and its threatened species. (Open-ended)

*1 Question not presented at Control Groups’ Questionnaire

*2 Questions 10.1 and 10.2 are only one, they were separated for analysis purposes

Survey Instrument implementation

The questionnaires were carried out with participating students before and after LZ-SEPs and with independent students that did not visit the Zoo.

Visiting Groups

The survey period occurred from September 2019 (beginning of school year) to March 2020. During this period, all LZ-SEPs of “Adaptations and Behaviours”, “Discovering Ecosystems” and “Darwin´s Route” were sampled. The Zoo opens at 10 a.m., therefore, schoolteachers were asked to begin the LZ-SEP at 10:15 a.m. to prevent any environment exposure bias (Oerke and Bogner, 2013). At this time, one Zoo Educator per class would apply the paper and pencil pre-questionnaire at any nearby location of the Zoo. Given the estimated response duration, at approximately 10:30 a.m. the same Zoo Educator would begin the LZ-SEP. After the program (~1:30 hours), the Zoo Educator applied the post-questionnaire and filled a form sheet with LZ-SEP notes (atypical events that could happen during the program).

Control Groups

To ensure a reliable measure of the impact of the LZ-SEPs and allow for meaningful comparisons (without pre-existing bias of visit expectation and students' preparation), we used a control group for each age group (Mellish et al., 2019). Our control group consisted of students' classes that had not come to Lisbon Zoo during that school year (2019/2020). At the end of the sampling period at the Zoo, between January and March 2020, we visited schools from the most sampled areas of the Country, where some classes were surveyed. Students had no prior knowledge of our visit. The questionnaires were identical to the pre-questionnaire of the visiting group, except for the question "Do you expect to like your visit to the Zoo?" as it did not apply.

Ethical Statement

As students' legal representatives, all teachers consent was requested for their participation, after being fully informed on the nature and purpose (thesis and publication) of the research and being provided with a questionnaire sample. All students were also completely informed (with age-appropriate language), before starting the questionnaires, that they had the right to not participate or withdraw their participation at any time.

Questionnaires were totally anonymous and no sensitive data (e.g. ethnicity, sexual lifestyle, religious or political opinion) was collected. Questionnaires were designed and applied to be light and enjoyable for students' ages, thus ensuring their well-being. All collected data is now part of Lisbon Zoo educational database and can only be used on further related research publications, ensuring students' right to confidentiality.

Data Processing

We sorted all open-ended question's answers, according to their specificity, into different categories, and later coded them. (Mellish et al., 2016; Roe and McConney, 2015).

For question 4, we organised all mentioned species into separate groups, one of which included all species that are not currently present at Lisbon Zoo. For species with ambiguous common names, these groups were pooled together applying the most used (e.g. references to African or Asian elephants were pooled together under "Elephant"). As for the reasons for species' preference pointed out by students, we created different theme classifications (e.g. "Animal physical and behavioural features" or "Animal is threatened" until all answers were covered (Carr, 2016)).

Question six, which was open-ended for 10-12 and 15-18 y.o., was transformed into a count, in the first case: students which can name two (2), one (1) or cannot name any (0) Pelican behaviours or adaptations. For older students, we sorted it into various categories, such as "Explained Pangea and different geographic barriers" or "Explained Natural Selection", according to their answers, until no new themes/categories were apparent.

For 13-15 and 15-18 age groups, open-ended question eight, was inserted in the four categories of ecosystems services referenced by the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment (MEA), 2005): Supporting, Provisioning, Regulating and Cultural Services.

Regarding questions 10.1 and 10.2, species were considered threatened when classified as "Vulnerable" or above by the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2020), or, in regard to native species, by the Livro Vermelho dos Vertebrados de Portugal (Cabral et al., 2005). We used the national assessment for native species as students are more likely to have had contact with such reality through school or environmental awareness programs education. When students referred a genus, "Tiger" for instance, we created a separate category from specific species, "Sumatran Tiger" for example, and was considered threatened if any species in the animal genus was classified as such by the IUCN Red List of Threatened Species (IUCN 2020). Threats were examined according to the World Wide Fund for Nature (WWF) Environmental Threats criteria (World Wildlife Fund, n.d.).

Lastly, mentioned actions in question 13, were classified into different categories, such as "Political Intervention" or "Sustainable use of energy and transports", according to their scope of impact on the environment, until all answers were covered (Kruse and Card, 2004; Maynard et al., 2020).

Statistical Analysis

Using MS Excel, we performed an exploratory graphical analysis, for all questions of each age group, including demographic information. All open ended questions were studied through category thematic analysis, which provides the opportunity to identify patterns in the qualitative data (Fischer and Young, 2007; Mellish et al., 2016).

Individual questionnaire items

To explore the effects of the LZ-SEPs on each question, univariate generalized linear models (GLM) or generalized linear mixed models (GLMM) (when suitable, i.e. significant random effects verified) were built for every response variable of each age group. Question no. 4 was the only one analysed exclusively through qualitative methods. In all models, "DK/DA" ("does not know/does not answer") responses were excluded. County and prior visit to the Zoo were accounted as random effects (for the GLMMs), weighing for possible bias, and treatments (control, pre- and post-questionnaires) were incorporated as fixed effects, after being converted to a dummy variable. Control-pre- and pre-post-questionnaires comparisons were performed, using control as indicator in comparisons between control and pre-program and pre- as indicator in comparisons between pre- and post-program. All model assumptions were examined through graphical analysis of residuals, fitted values and for every explanatory variable.

All models were fitted in the R environment (version 4.0.0). We used R package *ordinal* (Christensen, 2019) to perform Ordinal logistic regressions (CLM and CLMM) (link function *"logit"*) for Likert-scale questions, and *lme4* package (Bates et al., 2015), with Binomial, Poisson and Gaussian distributions (link functions "*logit*", "*log*" and "*identity*", respectively) for binomial, multiple-choice and open-ended questions. The *lmerTest* package (Kuznetsova et al., 2017), was used as a complement to *lme4*, for obtaining p-values.

Questions 10.1, 10.2 and 13 were transformed into binomial variables, "Ability to correctly name a threatened animal/threat/action" Vs "Lake of ability to (…)", thus allowing model analyses with Binomial distributions. The 6^{th} question of 10-12 y.o. was the only one analysed with a Poisson distribution. All remaining multiple-choices and open-ended questions were analysed with Gaussian distributions and their input values were computed using indices, considering the number of choices, student's number of answers and correct/incorrect answers (Box 1.1).

Box 1.1 - Indices used to analyse multiple-choices and open-ended questions.

Missions of a Zoo knowledge index (Q.3):

$$\textbf{Equation 1.1} \quad \frac{Correct\ \ choices}{2} - \frac{Incorrect\ \ choices}{4} \equiv \leq \ 0 \ \Rightarrow \ 0$$

Reptile characteristics knowledge index (Q. 5, ages 10-12):

$$\textbf{Equation 1.2} \quad \frac{Correct\ \ choices}{3} - \frac{Incorrect\ \ choices}{9} \equiv \leq \ 0 \ \Rightarrow \ 0$$

Ecosystem elements knowledge index (Q.5, ages 12-15):

$$\textbf{Equation 1.3} \quad "All\ of\ the\ above" + \frac{all\ other\ remaining\ \ choices}{6} \equiv \leq \ 0 \ \Rightarrow \ 0$$

Evolutionary features and types of Evolution knowledge index (Q.5, ages 15-18):

$$\textbf{Equation 1.4} \quad \frac{Correct\ \ choices}{2} - \frac{Incorrect\ \ choices}{6} \equiv \leq \ 0 \ \Rightarrow \ 0$$

Biotic Interactions knowledge index (Q.6, ages 12-15):

$$\textbf{Equation 1.5} \quad \frac{All\ choices}{6}$$

Natural selection and Continental Drift knowledge index (Q.6 ages 15-18):

$$\textbf{Equation 1.6} \quad \frac{3 \times ("Explained\ natural\ selection"\ answers)}{4} - \frac{remaining\ \ answers}{4} \equiv \leq \ 0 \ \Rightarrow \ 0$$

Plant importance understanding index (Q. 8, ages 10-12):

$$\textbf{Equation 1.7} \quad "All\ of\ the\ above" + \frac{all\ other\ remaining\ \ choices}{6} \equiv \leq \ 0 \ \Rightarrow \ 0$$

Plant importance understanding index (Q. 8, ages 12-15 and 15-18):

$$\textbf{Equation 1.8} \quad \frac{All\ choices}{4}$$

General outcomes of Emotion, Knowledge and Behaviour

To assess the global effects of the LZ-SEPs in each domain (as a whole), we created a general index for each domain of each age group and performed GLMs and GLMMs (when suitable) for every age group (Box 1.2).

For the indices creation, Likert-scale questions were rescaled to a 0-1 variable (0, 0.25, 0.5, 0.75, and 1) (Baggaley and Hull, 1983; Harwell and Gatti, 2001) and all other question results were used without modification. Within each domain, questions scores were then added and divided by the total number of questions of that domain, therefore generating an Emotion, a Cognitive and a Behaviour proxy index, ranging from 0 to 1.

Box 1.2 - General indices for each domain

Emotional Index:

$$\textbf{Equation 1.9} \quad \frac{Q.1+Q.2+Q.3}{3}$$

Cognitive Index:

$$\textbf{Equation 1.10} \quad \frac{Q.5+Q.6+Q.7}{3}$$

Behavioural Index:

$$\textbf{Equation 1.11} \quad \frac{Q.8+Q.9+Q.10.1+Q.10.2+Q.11+Q.12+Q.13}{7}$$

We compared domains changes between the three different treatments, converted to a dummy variable and incorporated them as fixed effects. County and prior visits to the Zoo were accounted for as random effects (GLMMs). Comparisons between control/pre- and pre-/post-program questionnaires were performed, using control as indicator class in comparisons between control and pre-program and pre- as indicator class in comparisons between pre- and post-program. Packages *lme4* (Bates et al., 2015) and *lmerTest* (Kuznetsova et al., 2017), were again used, with Gaussian distributions (link function "*identity*").

Emotion and Knowledge influence on Behaviour

Lastly, to assess the effects of the Emotion and Cognitive domains on Behaviour, we used the same indices equations (2.9., 2.10 and 2.11), but, this time, resorting solely to post-questionnaire data. Next, we built GLMs and GLMMs (when suitable) for each domain and age group.

Beforehand, we checked the non-existence of collinearity, rho <0.7 (Tabachnick et al., 2007), between the Emotion and Cognitive domains for all age groups, using a Spearman's Rho test. Then, we incorporated those indices as fixed effects and the Behaviour indices were considered our dependent variable. County and prior visits to the Zoo were included as random effects (GLMMs). Model adjustment was performed using packages *lme4* (Bates et al., 2015) and *lmerTest* (Kuznetsova et al., 2017), with Gaussian distribution (link function "*identity*")

Results

In total, 300 complete pre-post questionnaires were collected for each visiting students' age group, except for 12-15 y.o., where we only collected 217. Our goal was to collect 300 pre-post questionnaires for each age group, as recommended by (Balmford et al., 2005), however, due to the SARS-CoV-2 Pandemic and consequent Emergency State declared on the territory on March 19 2020, the Lisbon Zoo was closed until May 6th, which made further data collecting inviable. In the control group, we collected 200 complete questionnaires for each age group.

We did not find significant differences regarding prior visits to the Zoo and County data between control and visiting groups (Tab. A.1 and Fig. A.1, Appendix).

Empathy and concern towards nature and the Zoo

Overall, there were no significant differences regarding Zoo´s groups at arrival (pre-questionnaire) and control groups. Yet, it is noteworthy the significant difference in the perception of Zoos´ role by the 10-12 y.o., with control students demonstrating higher comprehension on the topic than students visiting the Zoo at arrival (Tab. 1.2).

Concerning students´ emotional perception of their visit to Lisbon Zoo (Q.1, Tab. 1.1), both 10-12 and 15-18 students demonstrated a significant higher satisfaction towards the visit than previously expected at arrival, with 12-15 students demonstrating a tendency towards the finding as well (Tab. 1.2).

Both 10-12 and 15-18 age groups showed a near-significant increased concern towards nature (Q.2, Tab. 1.1) after the LZ-SEPs. However, 12-15 students revealed no differences between treatments, pointing towards a similar level of concern afterwards (Tab. 3.1).

After the Programs, students of all ages revealed a significant increase in the awareness of Zoos as places to study and preserve species, and to educate rather than simply as a site to relax and see animals (Q.3 Tab. 1.1) (Tab. 1.2).

Table 1.2 - Parameters of the GLM and GLMM models relating the effect of each treatment (control, pre- and post-program) on students´ emotional domain answers. Sample size differed between questions and age groups due to the exclusion of DK/DA answers from the analyses. Treatment was converted to a dummy variable using control as indicator in comparisons between control and pre-program and pre- in comparisons between pre- and post-program. Significance was set at 0.05 (in *), near-significance represented with ·. Questions accordingly to Table 1.1.

Emotional Domain							
Question	**Ages**	**Treatment**	**Estimate**	**St.Error**	**z-value**	**t-value**	**P-value**
Control vs. Pre							
Q.2	10-12	Pre	-0.207	0.206	-1.004		0.316
	12-15	Pre	-0.005	0.208	-0.026		0.979
	15-18	Pre	0.263	0.247	1.062		0.288
Q.3	10-12	Pre	-0.090	0.032		-2.790	0.005 *
	12-15	Pre	-0.041	0.039		-1.061	0.289
	15-18	Pre	-0.030	0.035		-0.849	0.396
Pre vs Post							
Q.1	10-12	Post	0.562	0.182	3.086		0.002 *
	12-15	Post	0.341	0.204	1.672		0.095
	15-18	Post	0.418	0.175	2.394		0.017 *
Q.2	10-12	Post	0.361	0.188	1.920		0.055 ·
	12-15	Post	0.042	0.207	0.204		0.839
	15-18	Post	0.325	0.186	1.745		0.081
Q.3	10-12	Post	0.245	0.030		8.148	<0.001*
	12-15	Post	0.254	0.038		6.603	<0.001*
	15-18	Post	0.274	0.032		8.685	<0.001*

Mammals included the preferred species (Q.4, Tab. 1.1) among most students (79.3%, 82.5% and 84%, for 10-12, 12-15 and 15-18 age groups, respectively) (Tab. 1.3). Across all ages, the favourite species at arrival and for the control group was the dolphin, however, after LZ-SEPs, white tigers (*Panthera tigris*) (for 10-12 and 15-18 y.o.) and meerkats (*Suricata suricatta*) (for 12-15 y.o.) were favourites (Tab. 1.3). Noticeably, some students, especially the older age group, demonstrated an increased preference towards plants and amphibians after LZ-SEPs (Tab. A.2, A.3 and A.4, Appendix).

Both the control group and visiting group of all ages, before LZ-SEPs, indicated that the main reasons for choosing their favourite species were animals´ physical and behavioural characteristics, previously learnt, and emotional connections established towards the animal. Animals´ physical and behavioural characteristics continued to be the main motive after the programs, along with positive emotional or learning experiences lived during the program. It is also important to point out that, after the ZE-SEP, a considerably higher percentage of students indicated the threat level (all ages) and being a flagship species (15-18 y.o.) as reasons for preference (Tab. 1.4).

Table 1.3 - The 10 most common favourite species of each age group and treatment (control, pre- and post-program). Sample size varied with age group and treatment, 10-12:300, 12-15: 217 and 15-18: 300 for pre- and post-program and 200 for all ages in control.

Favourite Species	10-12 %			12-15 %			15-18 %			Mean %
	Control	Pre	Post	Control	Pre	Post	Control	Pre	Post	
Dolphin	14.5	12.0	5.67	10.5	16.6	7.4	10.0	8.7	3.0	9.8
Monkeys	10.5	10.7	8.00	12.0	10.6	6.9	11.0	7.0	4.0	9.0
Lion	9.0	11.3	7.33	12.5	9.2	5.5	11.5	5.3	3.0	8.3
Koala	6.5	5.3	4.67	6.0	3.2	8.3	4.5	6.3	6.8	5.7
Giraffe	3.0	3.7	5.00	7.0	6.9	5.5	5.5	7.7	4.7	5.4
Tiger	7.5	7.7	3.00	2.5	5.1	5.5	6.0	6.0	5.0	5.4
White Tiger	2.5	3.3	10.33	3.0	1.8	1.4	3.5	2.7	13.7	4.7
Meerkat	0.5	1.3	7.00	3.0	0.9	9.7	1.0	5.3	7.0	4.0
Penguin	2.5	2.7	7.00	3.0	2.3	2.8	3.0	5.0	3.0	3.5
Gorilla	0.5	2.7	5.67	0.0	0.0	8.0	2.5	3.0	5.7	3.3

Table 1.4 - Reasons indicated for favourite animal preferences of each age group and treatment (control, pre- and post-program). Sample size varied with age group and treatment, 10-12:300, 12-15: 217 and 15-18: 300 for pre- and post-program and 200 for all ages in control. * Not applicable.

Reasons	10-12 %			12-15 %			15-18 %			Mean %
	Control	Pre	Post	Control	Pre	Post	Control	Pre	Post	
Animal physical and behavioural features	61.5	45.0	38.0	45.0	44.7	32.7	32.5	37.0	24.3	40.1
Had a positive emotional or learning experience during the program *			16.3			20.3			15.0	17.2
Emotional connection with the animal	7.5	7.0	2.3	5.5	4.6	1.4	2.0	5.7	8.3	4.9
Threatened animal	4.0	0.7	2.3	3.5	0.9	3.7	4.5	3.7	5.0	3.1
Connection with animal´s habitat	1.5	2.7	0.7	0.5	2.8	0.9	1.0	1.7	0.3	1.3
Rare animal to find at a Zoo	0.0	1.7	0.0	1.0	0.9	0.9	0.5	0.7	0.0	0.6
Animal considered a Flagship species	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.3

Knowledge about biology

Analysing the 10-12 age group, we verified that control group students had a lower prior knowledge about reptiles (Q.5, Tab. 1.1) than students visiting the Zoo before the Program. Nevertheless, after the LZ-SEP, we observed a significant knowledge gain of the visiting group in all questions: reptiles, animals’ behaviours, and adaptations, with the used animal model (Q.6. Tab. 1.1), and in their understanding that not all birds can fly (Q.7, Tab. 1.1) (Tab. 1.5).

After the LZ-SEP, 12-15 y.o. knowledge on the elements that compose an ecosystem significantly increased (Q.5, Tab. 1.1). Despite their understanding of biotic interactions (Q.6, Tab. 1.1) being significantly lower for students visiting the Zoo at arrival (when compared to the control group), we also observed an increased knowledge in this question after the Program. Yet, the program had no relevant impact in students’ ability to understand the importance of carnivores in a trophic web (Q.7, Tab. 1.1): students continued with the perception that, when carnivores are extinct, herbivores will increase in number endlessly (Tab. 1.5).

When it comes to the older age group, there were no significant changes between the control and the pre-questionnaires. After the program, visiting students revealed a significant higher understanding of features’ evolutionary types and origin (Q.5, Tab. 1.1), and an increased understanding of the roles of natural selection and continental drift in evolution (Q.6, Tab. 1.1). However, there was no significant gain in students’ comprehension of drivers of evolution (Q.7, Tab. 1.1) as, after the LZ-SEP, they still believed that natural selection is the only driver of evolution, overlooking artificial selection, mutations, migrations or genetic drift (Tab. 1.5).

Table 1.5 - Parameters of the GLM and GLMM models relating the effect of each treatment (control, pre- and post-program) on students´ cognitive domain answers. Sample size differed between questions and age groups due to the exclusion of DK/DA answers from the analyses. Treatment was converted to a dummy variable using control as indicator in comparisons between control and pre-program and pre- in comparisons between pre- and post-program. Significance was set at 0.05 (in *). Questions accordingly to Table 1.1.

Cognitive Domain							
Question	**Ages**	**Treatment**	**Estimate**	**St.Error**	**z-value**	**t-value**	**P-value**
Control vs. Pre							
Q.5	10-12	Pre	-0.072	0.029		-2.449	0.015*
	12-15	Pre	-0.036	0.023		-1.544	0.123
	15-18	Pre	-0.017	0.041		-0.408	0.683
Q.6	10-12	Pre	0.446	0.280	1.595		0.111
	12-15	Pre	-0.206	0.034		-6.046	<0.001*
	15-18	Pre	<0.001	0.032		0.026	0.979
Q.7	10-12	Pre	-0.423	0.314	-1.351		0.177
	12-15	Pre	-0.116	0.376	-0.310		0.757
	15-18	Pre	0.229	0.210	1.091		0.275
Pre vs. Post							
Q.5	10-12	Post	0.113	0.026		4.313	<0.001*
	12-15	Post	0.055	0.022		2.504	0.013*
	15-18	Post	0.087	0.035		2.512	0.012*
Q.6	10-12	Post	0.894	0.176	5.074		<0.001*
	12-15	Post	0.107	0.036		2.961	0.003*
	15-18	Post	0.128	0.028		4.554	<0.001*
Q.7	10-12	Post	0.789	0.217	3.643		<0.001*
	12-15	Post	-0.172	0.312	-0.550		0.582
	15-18	Post	0.258	0.192	1.346		0.178

Awareness and behaviours regarding nature conservation

We verified that, in the 10-12 age group, students of the control group were significantly more aware of the importance of plants to the planet (Q.8, Tab. 1.1) than students of the same age group, when arriving at the Zoo. Yet, after LZ-SEPs, visiting students revealed a significant increase of understanding on the subject. In older groups, students were more able to describe one or more ecosystem services provided by plants (Q.8, Tab. 1.1) after the program, even if the increase was only near significant in the 15-18 age group (Tab. 1.9).

Contrary, when it comes to students' opinion on animal conservation being more important than plants' (Q.9, Tab. 1.1), the program produced no significant alterations in any age group (Tab. 1.9).

At arrival, the younger students, demonstrated a lower ability to correctly name a threatened animal (Q.10.1, Tab. 1.1), than the control group. After LZ-SEPs, we observed a significant increase in students' awareness about threatened animals for the 10-12 and 12-15 y.o. (Tab. 1.9). Across all ages, the 10 most mentioned threatened animals were mammals, even though we observed a rise in mentioned bird species, such as hyacinth macaw (*Anodorhynchus hyacinthinus*) or Bali myna (*Leucopsar rothschildi*), and in the ability to name complete correct species or subspecies, such as Amur tigers (*Panthera tigris altaica*) or Sumatran orangutans (*Pongo abelii*), after a program (Tab. A.5, A.6 and A.7, Appendix). This top 10 animals were roughly common across all age groups, with emphasis in the koala (*Phascolarctos cinereus*) and Iberian lynx (*Lynx pardinus*), both strongly cited across all treatments and age groups. Remarkably, the scimitar-horned oryx (*Oryx dammah*) was on top of students' references after the LZ-SEP, being a previously unmentioned animal in all age groups (Tab. 1.6).

Table 1.6 - The 10 most mentioned threatened animals by each age group and treatment (control, pre- and post-program). Sample size varied with age group and treatment, 10-12:300, 12-15: 217 and 15-18: 300 for pre- and post-program and 200 for all ages in control.

Threatened Animal	10-12 %			12-15 %			15-18 %			Mean %
	Control	Pre	Post	Control	Pre	Post	Control	Pre	Post	
Iberian Lynx	28.5	33.0	27.0	20.0	43.8	30.0	23.0	18.0	14.3	26.4
Koala	19.5	10.7	9.7	31.5	3.7	6.9	45.0	41.0	34.3	22.5
Giant Panda	15.5	7.7	2.7	8.5	3.2	3.2	5.0	9.3	3.7	6.5
Tiger	2.0	4.3	4.3	0.0	1.4	4.6	0.5	5.0	8.0	3.3
Scimitar-horned Oryx	0.0	0.0	7.0	0.0	0.0	12	0.0	0.0	7.3	2.9
Rhinoceros	1.0	1.0	4.7	1.0	2.8	3.2	3.0	4.0	4.7	2.8
Polar Bear	2.0	1.3	1.7	4.5	2.3	2.3	3.0	1.3	2.0	2.3
Elephant	2.5	0.3	3.3	2.5	2.3	4.6	0.5	0.7	2.3	2.1
Red Panda	3.0	2.0	3.0	0.0	0.0	1.8	0.0	1.0	0.7	1.3
Ring-tailed Lemur	0.0	0.3	0.0	0.0	0.0	5.5	0.0	0.0	0.0	0.6

At arrival, 15-18 y.o. visiting students demonstrated a significant lower ability to name a correct threat to their mentioned animal (Q.10.2, Tab. 1.1), when compared to the control group. This question was issued only to the two older groups and, after LZ-SEPs, both groups showed a significant increase in awareness of threats to biodiversity (Tab. 1.9). Of the correctly identified threats, we saw that both age groups, were particularly aware towards habitat destruction and illegal wildlife trade that made the bulk of their mentions across all treatments. Nevertheless, for older students, we verified that other threats presented during the program were more likely recognised afterwards, such as the effect of climate change and the impact of alien species (Tab. 1.7).

Table 1.7 - Threats identified by each age group and treatment (control, pre- and post-program). Sample size varied with age group and treatment, 12-15: 217 and 15-18: 300 for pre- and post-program and 200 for all ages in control.

Threats	12-15 %			15-18 %			Mean %
	Control	Pre	Post	Control	Pre	Post	
Habitat Destruction	34.8	11.0	13.0	48.2	40.9	34.1	30.3
Illegal Wildlife Trade	10.4	21.9	27.8	10.6	12.5	20.5	17.3
Effects of Climate Change	2.0	2.3	1.78	3.0	2.0	3.6	2.4
Pollution	1.0	2.3	0.9	0.0	1.4	0.7	1.1
Overfishing	0.0	0.0	0.0	0.0	0.3	0.0	0.1
Impact of Alien Species	0.0	0.0	0.0	0.0	0.0	0.7	0.1

In reference to student's perception of Lisbon Zoo as an important driver of species conservation (Q.11, Tab. 1.1), only the older students revealed significantly greater understanding at arrival, when compared to the control group. For 10-12 and 12-15 y.o., there were no significant dissimilarities between treatments. However, after LZ-SEPs, all visiting age groups attributed a significantly higher importance to the Zoo's role in conservation. (Tab. 1.9).

We did not observe significant differences between control groups and pre-questionnaires on students' opinions about their role in helping conservation (Q.12, Tab. 1.1). After the LZ-SEP, older students showed an increased perception of their potential for impact, which was not observed in younger age groups (Tab.1.9).

When it comes to students' actual ability to name a common or daily practice useful for nature conservation (Q.13, Tab. 1.1), there were no significant differences between the control and the students at arrival. We verified a significant increase in this ability for the older age groups (12-15 and 15-18), after the LZ-SEP (Tab.1.9). Often students named more than one practice but, by far, the most named actions in all age groups, and treatments, fell in the category of waste reduction and separation (from polluting less to recycling). Next in number of references, there was responsible consumptions habits, either regarding resources and manufactured materials, wildlife trade or food choices. These were the most tangible practices for students in all ages, a pattern reinforced after LZ-SEPs. It is noteworthy that, after the LZ-SEPs, environmentally friendly daily practices, that were little or not mentioned before, took a more significant value in the replies, these including: having responsible consumption habits when buying certified products (such as Rainforest Alliance certified, Dolphin Safe, etc.), or engaging in political interventions (from voting, to protesting for their beliefs), even at younger ages (Tab.1.8).

Table 1.8 - Individual environmental practices categories mentioned by each age group and treatment (control, pre- and post-program). Each student could name more than one practice. Sample size varied with age group and treatment, 10-12: 217 control, 325 pre and 339 post; 12-15: 229 control, 243 pre and 245 post; 15-18: 240 control, 348 pre and 408 post.

Actions	**10-12 %**			**12-15 %**			**15-18 %**			**Mean %**
	Control	Pre	Post	Control	Pre	Post	Control	Pre	Post	
Waste/Residue Reduction and Separation	37.8	32.0	33.3	31.4	29.2	35.9	29.2	36.2	32.1	33.0
Responsible Consumption Habits (Resources and Manufactured Materials)	9.7	4.0	9.1	8.7	7.4	4.5	13.3	9.8	16.4	9.2
Responsible Consumption Habits (Wildlife Trade)	1.4	4.6	12.7	0.4	6.2	11.4	2.1	2.0	7.4	5.4
Responsible Consumption Habits (Food Choices)	4.1	1.8	5.6	6.6	4.5	1.6	6.7	4.6	5.4	4.5
Social Intervention	3.2	1.5	0.6	1.3	4.1	4.1	3.8	5.5	2.0	2.9
Learn more and Educate others	0.9	1.8	2.1	2.2	1.6	0.0	2.9	3.2	6.4	2.3
Financial Aid	0.5	0.3	0.3	1.7	1.6	2.4	3.8	3.4	2.0	1.8
Sustainable use of Energy and Transports	1.8	1.8	1.2	0.9	0.8	2.0	1.7	1.4	2.9	1.6
Responsible Consumption Habits (Certified Products)	0.0	0.0	1.2	0.0	0.0	4.9	0.0	0.0	7.1	1.5
Political Intervention	0.0	0.0	0.9	0.0	0.0	1.2	0.8	0.6	0.7	0.5

Table 1.9 - Parameters of the GLM and GLMM models relating the effect of each treatment (control, pre- and post-program) on students´ behavioural domain answers. Sample size differed between questions and age groups due to the exclusion of DK/DA answers from the analyses. Treatment was converted to a dummy variable using control as indicator in comparisons between control and pre-program and pre- in comparisons between pre- and post-program. Significance was set at 0.05 (in *), near-significance represented with · Questions accordingly to Table 1.1.

Behavioural Domain							
Question	**Ages**	**Treatment**	**Estimate**	**St.Error**	**z-value**	**t-value**	**P-value**
Control vs. Pre							
Q.8	10-12	Pre	-0.055	0.022		-2.433	0.025*
	12-15	Pre	0.002	0.010		0.196	0.845
	15-18	Pre	-0.006	0.018		0.018	0.737
Q.9	10-12	Pre	0.264	0.179	1.476		0.140
	12-15	Pre	0.153	0.185	0.828		0.408
	15-18	Pre	-0.093	0.170	-0.55		0.583
Q.10.1	10-12	Pre	-1.035	0.298	-3.469		<0.001*
	12-15	Pre	-0.181	0.230	-0.787		0.431
	15-18	Pre	0.321	0.252	1.275		0.202
Q.10.2	12-15	Pre	-0.254	0.307	-0.826		0.409
	15-18	Pre	-0.599	0.349	-1.717		0.086 ·
Q.11	10-12	Pre	0.168	0.182	0.928		0.353
	12-15	Pre	0.033	0.191	0.174		0.862
	15-18	Pre	0.402	0.180	2.241		0.025*
Q.12	10-12	Pre	-0.047	0.195	-0.240		0.810
	12-15	Pre	0.098	0.199	0.491		0.623
	15-18	Pre	0.164	0.185	0.889		0.374
Q.13	10-12	Pre	0.095	0.234	0.405		0.685
	12-15	Pre	0.003	0.525	0.006		0.995
	15-18	Pre	-0.175	0.330	-0.531		0.595
Pre vs. Post							
Q.8	10-12	Post	0.038	0.018		2.113	0.035*
	12-15	Post	0.015	0.009		1.763	0.079 ·
	15-18	Post	0.078	0.016		4.965	<0.001*
Q.9	10-12	Post	0.083	0.160	0.521		0.602
	12-15	Post	0.009	0.176	0.051		0.960
	15-18	Post	0.169	0.149	1.129		0.259
Q.10.1	10-12	Post	0.409	0.190	2.156		0.031*
	12-15	Post	0.727	0.255	2.855		0.004*
	15-18	Post	-0.137	0.235	-0.585		0.558
Q.10.2	12-15	Post	0.857	0.360	2.383		0.017*
	15-18	Post	0.630	0.313	2.015		0.044*
Q.11	10-12	Post	1.047	0.183	5.718		<0.001*
	12-15	Post	0.789	0.202	3.898		<0.001*
	15-18	Post	0.937	0.177	5.283		<0.001*
Q.12	10-12	Post	0.151	0.176	0.856		0.392
	12-15	Post	0.175	0.194	0.904		0.366
	15-18	Post	0.418	0.163	2.557		0.011*
Q.13	10-12	Post	-0.325	0.212	-1.533		0.125
	12-15	Post	0.992	0.305	3.252		0.001*
	15-18	Post	1.076	0.345	3.121		0.002*

General outcomes of Emotion, Knowledge and Behaviour

We observed a significant difference between the control and students at arrival, in the Emotional and Cognitive domain for older students (15-18 age group), and in the Behavioural domain, for the younger ones (10-12 age group). On the other hand, after LZ-SEPs, we verified a significant increase in emotional connection, knowledge gain and behavioural change propensity indexes, for students of all age groups (Tab.1.10).

Table 1.10 - Parameters of the GLM and GLMM models relating the effect of each treatment (control, pre- and post-program) on the three domains considered. Sample size differed between domains and age groups due to the exclusion of DK/DA answers from the analyses. Treatment was converted to a dummy variable using control as indicator in comparisons between control and pre-program and pre- as indicator in comparisons between pre- and post-program. Significance was set at 0.05.

Domain	Ages	Treatment	Estimate	St. Error	t-value	P-value
Control vs. Pre						
	10-12	Pre	<0.001	<0.001	0.005	0.996
Emotional	12-15	Pre	0.038	0.029	1.324	0.352
	15-18	Pre	-0.046	0.022	-2.107	0.040*
	10-12	Pre	0.085	0.029	2.884	0.006*
Cognitive	12-15	Pre	-0.081	0.038	-2.126	0.153
	15-18	Pre	-0.053	0.023	-2.330	0.020*
	10-12	Pre	0.105	0.016	6.410	<0.001*
Behavioural	12-15	Pre	-0.013	0.019	-0.654	0.513
	15-18	Pre	0.002	0.020	0.111	0.912
Pre vs Post						
	10-12	Post	0.120	0.015	7.924	<0.001*
Emotional	12-15	Post	0.091	0.021	4.358	<0.001*
	15-18	Post	0.110	0.013	8.262	<0.001*
	10-12	Post	0.180	0.021	8.725	<0.001*
Cognitive	12-15	Post	0.073	0.017	4.276	<0.001*
	15-18	Post	0.129	0.020	6.343	<0.001*
	10-12	Post	0.098	0.015	6.531	<0.001*
Behavioural	12-15	Post	0.063	0.018	3.392	<0.001*
	15-18	Post	0.129	0.020	6.343	<0.001*

Emotion and Knowledge influence on Behaviour

Concerning the role that emotion and knowledge play in students' predisposition for behavioural change, we observed a significant positive relationship between emotion and behaviour, for younger age groups (10-12 and 12-15) and between knowledge and behaviour, for the older students (15-18) (Tab.1.11).

Table 1.11 - Parameters of the GLM and GLMM models relating the influence of emotional and cognitive domains in students' predisposition to behavioural change (behavioural domain) after LZ-SEPs (post-program answers). Sample size differed between age groups due to the exclusion of DK/DA answers from the analyses. Significance was set at 0.05 (in *).

Domains	Ages	Estimate	St.Error	t-value	P-value
(Intercept)		0.282	0.038	7.477	<0.001*
Emotional	10-12	0.252	0.049	5.165	<0.001*
Cognitive		0.051	0.031	1.618	0.107
(Intercept)		0.220	0.060	3.692	0.010*
Emotional	12-15	0.380	0.050	7.541	<0.001*
Cognitive		0.086	0.060	1.424	0.156
(Intercept)		0.532	0.045	11.831	<0.001*
Emotional	15-18	0.090	0.051	1.771	0.078
Cognitive		0.070	0.033	2.124	0.035*

Discussion

This study assessed the impact that three School Education Programs of Lisbon Zoo had on students' Emotion, Knowledge and Behaviour towards nature conservation. Results revealed a positive cumulative influence on all three domains for 10-18 y.o students. Nonetheless, some specific outcomes, namely nature awareness, knowledge about ecosystems or evolution, concern about plants, and the ability to name useful pro-conservation actions, were not reached in all age groups. Furthermore, we found a positive relation between the Emotional and Behavioural domains in 10-12 and 12-15 y.o. students and between the Cognitive and Behavioural in 15-18 y.o.

These results support all our study initial hypotheses. However, it is important to mention, that control students showed better performance than visiting students in some specific aspects of the inquiries (Tab. 1.2; 1.5 and 1.9). Such may be due to several individual sociodemographic variables that we were unable to collect, for instance, access to green spaces, parents' occupation and education, among others (Jensen, 2014), preventing further interpretations of these differences. Also, worth mentioning is the lower Cognitive and Behavioural metrics that 10-12 y.o. control students revealed when compared to visiting students at arrival. As it is mentioned by visiting teachers, in Zoo´s annual inquiries, they often introduce their students to the Zoo before the visit. This preparation, although beneficial, could explain the observed differences (Dohn, 2013), as the control group had no preparation. On the other hand, 15-18 y.o. control students showed higher Emotional and Cognitive domains when compared to visiting students at arrival. This may be explained by the environment where the questionnaires were answered, as classrooms are often more conducive to students attention (Jensen, 2014), whereas the Zoo is a novel, exciting environment. With these possibilities and constraints in mind, it was possible to assume our sample as relatively representative of the general school audience.

Empathy and concern towards nature and the Zoo

After the LZ-SEPs, students of all ages reported stronger empathy and concern, not only towards the Zoo but with nature in general. These results support previous findings, that Zoos provide meaningful experiences, with the ability to stimulate positive affective responses, in children and adolescent, towards nature (Clayton et al., 2009; Powell and Bullock, 2014).

The LZ-SEPs accomplished great personal fulfilment regarding students' visit to the Zoo, even more than previously expected by themselves. Furthermore, our results showed a near-significant increase of care and concern for nature in the younger and older age groups. These findings are consistent with numerous child development theories, since the hands-on experiences that the Lisbon Zoo environment provided, had the power to encourage children and adolescents' affection and interest towards nature (Jensen, 2014; Kellert et al., 2002). Such can largely be due to children having had close encounters with wild animals, which inspires their love, connection and concern, more than any book, movie or game can ever accomplish (Dohn et al., 2013; Powell and Bullock, 2014). The increased concern was not more significant, arguably, because of a "ceiling effect" (i.e. high proportion of maximum scores) (Falk et al., 2007), caused by the high levels of concern that the students already demonstrated at Zoo arrival.

With our findings confirming the unique setting that Zoos offer for nature engagement, we respectfully propose that we may consider the existence of 4 educators: the Teacher, the Zoo Educator, the environment and the animal itself, broadening the theory of Bone (2013) on animals being the 4th element of education in a child's pedagogical setting. When considering Zoo animals as the 4th educator in LZ-SEPs, it is extremely important to look at students' relationship with them, which we achieved through analysis of their favourite species and motivations.

Not surprisingly, for all age-groups and treatments, mammals were favourites, corresponding to 9 of students' top 10 favourite's species. Previous studies (Carr, 2016; Moss and Esson, 2010) found the same pattern, explained by the attractive physical and behavioural traits of this class. Such is consistent with our findings, given that "animals' physical and behavioural features" and "empathy/emotional connection with the animal" (either before or as a result of the LZ-SEP) were the main preference motivations, pointed by students of all ages. Across the world, the main factors influencing Zoos species attractiveness, are animals' body size and length, colour, rarity, proximity to the visitor, activity and anthropomorphic/relatable features (Carr, 2016; Woods, 2000). This justifies Lisbon Zoo students' choices: large primates and ungulates, big cats and other charismatic, quite interactive species, such as dolphins, meerkats or penguins (Landová et al., 2018; Skibins et al., 2017). Furthermore, Moss and Esson (2010) suggested that visitors come to Zoos already with expectations to see certain species. Since, most children's books (62%), pets and, even biology classes' examples, are mammals (Woods, 2000), Moss and Esson (2010) suggestion may also pose an explanation to our results.

The influence of such expectations was additionally supported, when we compared control, pre- and post-programs choices: both the control group and the recently arrived (pre-) students named dolphins as their favourite species. Bottlenose dolphins (*Tursiops truncatus*) are part of the major Animal Presentation at Lisbon Zoo, being strongly cherished by the public. Since 90% of our control and 86.7% of visiting groups had already been at the Zoo, students' favourite species choice was likely drove by previous visits experiences. However, after LZ-SEPs, 10-12 and 15-18 y.o. students favoured white tigers while 12-15 y.o. favoured meerkats. Since both species are considered charismatic and iconic, often Zoo Educators tend to include them on their route, using them as examples for different thematic. This leads to "positive emotional or learning experiences lived during the program" to join "animal attractiveness" as reasons students' recognise. Our results highlight the power of LZ-SEPs as emotional drivers, already described by Carr (2016) that discovered that interesting talks given by Zoo Educators were among the main reasons pointed by participants for species favouritism. Accordingly, an increased preference in plant and amphibian species, and the importance of species conservation status as motivation, was registered after LZ-SEPs. Hence, we call attention for Zoo Educators to balance both charismatic and less common, often more endangered, species, when delivering LZ-SEPs, to enhance their conservation strategy delivery.

Regarding students perceptions on Zoos' role, our data from the control and before the LZ-SEP, supports previous studies claims that students take Zoos as places of entertainment, for enjoyment, but also recognise their missions' value (Roe and McConney, 2015; Tofield et al., 2003). Students come with their school teachers and their respective educational agendas, which, according to Davidson et al. (2010) is a determining factor in students expectations and perceptions of a Zoo field-trip. Moreover, prior visits to the Zoo and increased efforts among Zoos to be recognised, and to inform people about their missions, also clarify our findings (Roe and McConney, 2015). Nevertheless, and concurring with other studies (Clayton et al., 2009; Falk et al., 2007), after the LZ-SEP, students of all ages significantly improved their insight on Zoos' Conservation, Education and Research value.

As Emotion is considered the motivational driver of Learning (Powell and Bullock, 2014), LZ-SEPs can facilitate students learning process because of this increased concern and eagerness for information (Clayton et al., 2009).

Knowledge about biology

The LZ-SEPs promoted students' short-term biology learning across all age groups, demonstrating the educational potential that Zoos have for children and adolescents. Despite encouraging, this was not an unexpected result, since numerous studies had already described the learning potential of other Zoos educational interventions (Collins et al., 2020; Jensen, 2014; Randler et al., 2012).

Our results are probably due to the solid link that the informal LZ-SEPs establish with students' formal school curriculum, as well as their learner-centred approach, previously highlighted as essentials in promoting students' knowledge gain (Braund and Reiss, 2006; Randler et al., 2012). Moreover, Lisbon Zoo implements strong programs of Environmental Enrichment, aiming at stimulating animals' natural behaviours and welfare (Bloomsmith et al., 1991). This daily demonstrations of such behaviours by Zoo animals, along with, evermore, immersive natural enclosures, have proven to facilitate wildlife biology knowledge learning and retention (Collins et al. 2020, Randler et al., 2012). Through first-hand observations of the animals, students seemed to interlink the previously theoretical, biology concepts, formulating a much deeper understanding and explaining our positive results.

Upon our findings, we must agree with Randler et al. (2012), who suggested that, the informal learning at Zoos should be included in the formal education of schools, to enhance both biology and conservation outcomes. Since the LZ-SEPs are recognised as of educational utility by the Portuguese Education Ministry, most teachers probably take their students to the Zoo already with a learning agenda, resorting to the Programs either as an introduction to specific biology contents or for consolidation of the curriculum. As a result, students are, at least, familiar with the Knowledge domain topics approached in each LZ-SEPs, leading to even more positive outcomes and retention immediately after the Programs. For these outcomes to sustain long-term and enhance post-Program retention, we suggest that LZ-SEPs contents should be worked afterwards, at schools, through teachers-Zoo partnerships (Sattler and Bogner, 2017).

Nevertheless, even with the LZ-SEPs being shown effective in increasing knowledge regarding the main thematic areas of their school curriculum, it is important to address some questions where, such did not happen. For instance, 12-15 y.o. remained with a misunderstood idea regarding the importance of predators in a trophic web (Q.7, Tab. 1.1). This may be because not all Zoo Educators address this topic directly during the LZ-SEPs. Ecosystem balance is a mandatory Program topic, but it can be differentially approached, and "Predators" are one of the most recent additions to LZ-SEPs. It is also noteworthy that this age group is the least frequent at LZ-SEPs. With an estimation of 750 students per year, the majority of Zoo Educators, are less experienced at it, which is possibly influencing students' misconceptions. In its turn, 15-18 y.o. students showed no gain in their comprehension of evolution drivers besides natural selection (Q.7. Tab. 1.1). However, students already demonstrated a great understanding of this subject upon Zoo arrival, verified in the pre-questionnaires, possibly causing a "ceiling effect" (Falk et al., 2007) in which we can attribute this stability in knowledge. Given the growing evidence on the influence that Learning can exert on Behaviour (Littledyke, 2008; Maynard et al., 2020), stimulating students' knowledge is crucial.

Awareness and behaviours regarding nature conservation

LZ-SEPs successfully improved student's nature conservation understanding and willingness to engage in pro-conservation behavioural changes in all ages, a result supported by previous works at other Zoos (Grajal et al., 2017; Mann et al., 2018).

When looking specifically at students' conservation understanding (Q.8, Q.9, Q.10.1 and Q.10.2), we observed increases in almost every question and age, with few exceptions. Children understood better the importance that plants and animals play in the ecosystem, their current conservation status, and threats. Furthermore, after LZ-SEPs, all age groups revealed stronger comprehension of Lisbon Zoo conservational value (Q.11), similar to what was verified by Falk et al (2007) in different Zoos. Connectedness with wild animals along with the explanation of their threats through practical examples, probably generated new ideas about them and nature in general, triggering consciousness among students and encouraging them to rethink preconceived ideas and actions (Hughes, 2013; Powell and Bullock 2014).

Before the Programs, students' knowledge of "endangered species", was almost restricted to two: the Iberian lynx and the koala. The first one was somehow unexpected, since, until quite recently, this endemic species was not very familiar to the Portuguese population (Lopes-Fernandes et al., 2018). Lisbon Zoo, together with the Instituto da Conservação da Natureza e das Florestas and the Centro Nacional de Reprodução do Lince Ibérico, among others, have directed strong efforts to turn the Iberian lynx into a flagship species for Portuguese biodiversity. As a result, children are now more in contact with information about this species, through environmental education actions at school, and even at the Lisbon Zoo, which according to our study results is being effective. In contrast, references to koala were predictable, since most of the questionnaires were conducted during the 2019-2020 bushfires crisis in Australia which severely affected this species (Lam et al., 2020). The fires led to massive media coverage and international conservation campaigns, which drove students' awareness for the species.

Additionally, the most mentioned species, even after LZ-SEPs, were charismatic mammals, and the mentioned threats mainly consisted of "Habitat Destruction" and "Illegal Wildlife Trade", highlighting the importance of Emotion on species conservation. Moreover, it brings attention to the role that flagship species and adequate Media coverage play on people´s awareness (Carr, 2016). Even so, we must emphasize that after the Programs, all ages largely referred the Scimitar-horned-oryx, the only "Extinct in the Wild" species at the Zoo, and were more familiar with other environmental threats, unveiling the impact that a single intervention at the Zoo can have on students conservation consciousness.

However, there were a few exceptions to this increased awareness: the importance that students placed on plant conservation and, for the 15-18 y.o. the ability to recognize one threatened animal. The poor results relating to the first question may be due to the importance that LZ-SEPs places on plants: even though Zoo Educators always address and show, at least, two plant species, it is normal for the emphasis to be on animals, since they are the focus of Lisbon Zoo's work. Furthermore, people are already more prone to animals, when compared to plants, exhibiting what some authors call "plant blindness" (Balding and Williams, 2016). This "blindness" has a multitude of cultural and psychological reasons, but scientists agree that it takes more than one intervention and implies reinforced exposures to alter it (Balding and Williams, 2016). Nonetheless, it does not mean that the intervention has not increased students' knowledge and interest in plants. We verified it with Q. 8, which may stimulate future plant engagement in other natural areas, triggering the intended reinforced exposure (Balding and Williams, 2016; Littledyke, 2008). Since LZ-SEPs have limited time, without shifting the animal focus, we suggest that the view of Balding and Williams (2016) should be implemented to increase plant empathy. Concerning the ability to name a threatened animal, the result was somehow predictable, since Darwin's Route Program focus is particularly related to students' school curriculum. Such is due to the denser biology curriculum contents of the 15-18 students that leads the LZ-SEP to present fewer behavioural outcomes. To strengthen these outcomes, Lisbon Zoo offers an additional Program "Discovering Biodiversity" that strongly emphasizes conservation and behaviour change. As such, teachers often chose to attend both Programs with their students and, probably, only through assessment of both Programs together could we have had a different result when it comes to such questions.

Concerning students self-reported perceived behaviours, we observed that the LZ-SEPs reinforced older students' beliefs of their importance in nature conservation, supporting previous findings at other Zoos (Counsell et al., 2020; Falk et al., 2007). One single intervention at the Zoo thus proved to be effective in the environmental identity of older students, nurturing their confidence, and thus following TPB recommendations (Mann et al., 2018). However, we did not see this for the 10-12 and 12-15 y.o. Such can be attributed to the "ceiling effect", since in the pre-questionnaires the tendency to choose the highest point in the Likert-scale was already very high (Falk et al., 2007). It may be that the younger students do indeed feel more inspired and influential at Zoo arrival than other age groups, but this can also point towards a social desirability bias, more frequently observed in younger ages (Oerke and Bogner, 2013).

Contrary, it was the 12-15 and 15-18 y.o. that increased their ability to name, and willingness to participate, in pro-conservation behaviours after LZ-SEPs. Before the Programs, students named widely generic actions that could help conservation, such as "do not pollute". However, after the Programs, their conservation awareness increased, translated into a diverse range of pro-environment behaviours that they were predisposed to take. From simple "Recycling" to more complex actions, like "Participate in political interventions", the results agree with the model of Zoos being facilitators for people´s reflection on the relationship between threats and their own behaviour (Grajal et al., 2017).

These successful behaviour indicators, are explained by the behaviour change guidelines that Lisbon Zoo Education Strategy follows:

(1) Provide information on specific actions and practical examples that students can apply. When presented with an environmental problem/threat, students are always pointed towards a useful solution (Ballantyne et al., 2007), which we argue to be extremely important in "environmental identity empowerment".

(2) Zoo Educators try to consider students' prior experiences and motivations for action (Mann et al., 2018), often resorting to students' personal experiences. This way, Programs make conservation personal and tangible, which is extremely important in behavioural change strategy (Stevenson et al., 2014).

(3) LZ-SEPs are interpretative, engaging, and positive experiences that help students interlink their Programs experience with their real-life (Hughes, 2013; Mann et al., 2018). Often, Educators are encouraged to resort to storytelling, role-play, or visual aids to engage students in the Program. These communication techniques are proven to increase, not only students' comprehension on conservation subjects, but also trigger interest in future involvement (Davidson et al., 2010; Mellish et al., 2016). Nonetheless, it is, possibly, a problem in the employment of this guideline that explains 10-12 y.o. unchanged capacity to name pro-conservation behaviours. Some physiologists mention younger children's difficulty to make meaning of learned actions, as the behaviour stays, often, abstract in their minds and they are not able to translate them into real events (White and Stoecklin, 2008). To tackle this problem, frequently, further reinforcement measures are applied (Hughes, 2013).

(4) Finally, the LZ-SEPs are well adapted to their target audience (Ballantyne et al., 2007). Students benefit form specific programs that approach conservation according to their age and are designed through active learning principles for school audiences (Collins et al., 2020; White and Stoecklin, 2008).

Yet, if one is to infer on Programs success, we must look at the effects that each Emotion and Knowledge may play (or not) on students Behaviour (Powell and Bullock, 2014).

Emotion and Knowledge influence on Behaviour

We found a positive relationship between Emotion and Behaviour for the 10-12 and 12-15 age groups and between Knowledge and Behaviour for the older students. These results were, somehow, surprising. The effect that, both connectedness and knowledge about nature, play on behavioural change strategies is relatively understood (Mann et al., 2018; 2018; Otto and Pensini, 2017). But the difference between ages were not anticipated, given that few studies ever addressed such broad age-ranges (Powell and Bullock, 2014).

From previous studies, it seemed that the foundation for behavioural change was Emotion (Grajal et al., 2017). Establishing a deeper appreciation towards nature leads to an increase interest in learning more about it (Grajal et al., 2017). In turn, more educated students are then prone to engage in pro-conservation behaviours (Littledyke, 2008, Jensen et al., 2014). However, similar to other studies, we did not verify a direct correlation between Emotion and Knowledge (Roczen et al., 2014; Otto and Pensini, 2017). Our results showing Emotion effects on Behaviour are in agreement with Otto and Pensini (2017), who found that connectedness with nature had the greater influence (69%) on 4th to 6th-grade students' pro-environment behaviours, contrary to Knowledge, that had a small effect (2%). Similar to previous studies regarding older students, our study emphasized the value that Knowledge plays in promoting environmental awareness (Jensen et al., 2017). Therefore, our results may be due to differences in students' developmental stages. In sum, these positive outcomes, support the need to incorporate Emotion, Knowledge and Behaviour in an integrated approach, with age-appropriate features, for successful Zoo Education delivery.

Study limitations and future research

Although we undertook several of Mellish et al. (2019) recommendations, when building our survey design, there are still some important considerations to account for. Perhaps the most detectable limitation of our study, was that we did not explore the effects of possible confounding variables, such as students' sociodemographic information (e.g. parents-education, social class, pet-ownership, etc.) and different teachers' role (Jensen 2014). We were unable to collect this data due to protection policies and time constraints. For our study, we considered that the training of Educators and the standardization of LZ-SEP ensured a good calibration between Programs. However, different interpretative tours may influence different outcomes, given the wide range of contents and freedom of approach, which should be assessed in the future. Another evident issue is the possibility of social desirability bias on students' self-reported measures of Emotion and Behaviour (Oerke and Bogner, 2013). We tackled this problem by employing question formulation techniques, that proved to minimize this bias, and by conducting the questionnaires anonymously (Bell, 2007; Taherdoost, 2016). Despite our attempts, we observed "ceiling effects" in various questions, which raised some doubts in interpretation. Therefore, in future assessments, we propose adding a social desirability measure to the survey. Regarding measures on behavioural change, the major limitation in all studies, consists on the data dependency on students self-reported intended behaviours (Bueddefeld Van Winkle, 2017; Jensen et al., 2017). Finally, we must address the disadvantages of employing open-ended questions on young children. Even though they offer an in-depth look into students' perceptions, they are subjective and cause constraints in categorisation, due to students' different levels of literacy. For instance, it is noteworthy that we had limitations in further cataloguing animals identified as "Monkeys" or "Tigers", which means that students could be referring to different species/subspecies present at the Zoo, conditioning the interpretation of our results. Without time constraints, we could instead perform mixed-method approaches, including both written questionnaires and oral interviews (Mellish et al., 2019).

LZ-SEP and Conservation implications

Our study represents the first-ever large scale, scientific, assessment of LZ-SEPs. Hence, the results will be crucial in future Programs development and implementation, as we provided clear evidence of their impacts on students Emotion, Knowledge and Behaviour. We also identified some short-comes that need to be addressed. Questions that did not result in a significant effect should be thoroughly approached at future Zoo team training and Zoo Educators should be called to action for solutions. However, our study only explored the short-term effects of LZ-SEP, so we stress the need for further research on students' long-term outcomes, to verify its persistence. Moreover, our methodological design would greatly benefit from a comparison between schools participating in the LZ-SEPs and free-visiting schools, which would allow further validation of these Programs' impact. There are also several other LZ-SEPs (in-Zoo and in-school, with younger and older age-groups) in which our study design could be applied, providing outcomes assessment and improvement, which would allow the Education Department to succeed in its Education Strategy.

This study also produced an innovative way of measuring the impact that Emotion and Knowledge play on students' Behaviour. Emotion was the main driver of Behaviour at young ages, but, it seems that older students, when already demonstrating appreciation towards nature, tend to be more willing to engage in pro-environment behaviours when their interest is triggered by new information (Learning). These findings embody the core of LZ-SEPs intent: if children experience wild-life up-close they will love it, if they love it, they will want to learn more about it and, by learning, they will want to protect it. In conclusion, to enhance students experience at Zoos, nurturing their "biophilia" feelings and triggering positive behavioural changes, that ultimately may lead to species conservation, we suggest that this LLP strategy (Love, Learn, Protect) of Lisbon Zoo ought to be considered.

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Appendix

Table A.1 – Relative frequency of control and visiting students by county (%). Control N=200 for all ages; Visiting N=300 for 10-12 and 15-18 y.o. and 217 for 12-15 y.o.

	Control			Visiting		
County	**10 - 12**	**12 - 15**	**15 - 18**	**10 - 12**	**12 - 15**	**15 - 18**
Almada	16.5	17.5	10.0	-	-	-
Amadora	25.5	39.0	43.0	-	-	-
Cacém	-	16.5	12.0	-	-	-
Cascais	-	-	11.5	-	-	17.0
Leiria	-	-	19.5	-	-	20.7
Lisboa	24.5	25.0	-	74.7	-	34.0
Mafra	-	-	-	-	70.0	-
Odivelas	33.5	2.0	-	-	-	-
Santarém	-	-	-	-	-	7.7
Sintra	-	-	4.0	-	-	14.3
Torres Vedras	-	-	-	-	30.0	-
Vila Franca de Xira	-	-	-	25.3	-	-
Vila Real de Santo António	-	-	-	-	-	6.3

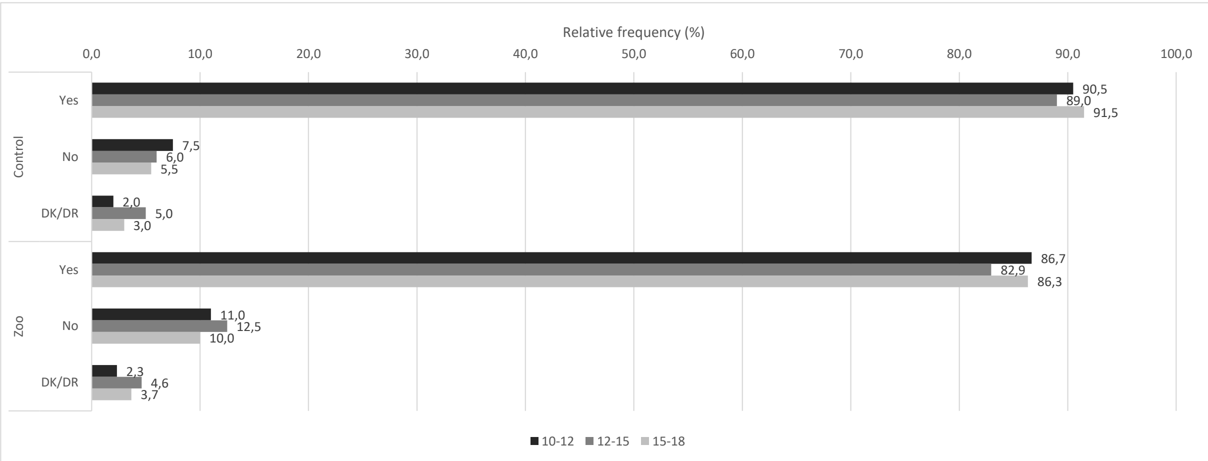

Figure A.1 – Relative frequency of students' responses on prior visit to Lisbon Zoo (%). Control N=200 for all ages; Visiting N=300 for 10-12 and 15-18 y.o. and 217 for 12-15 y.o.

Table A.2 – Frequency of all favourite species mentioned by 10-12 y.o. students in each treatment (control, pre- and post-program).

Favourite Species	Control	Pre	Post
DK/DR	14	28	15
Animals that do not exist at the zoo	22	15	0
Penguin	5	8	21
Pelican	0	0	3
Flamingo	2	3	9
Red-crowned Crane	0	1	0
Macaw	1	0	0
Red-and-green Macaw	0	0	1
Parrot	1	3	0
Owl	0	1	0
Eagle	0	2	0
Peacock	2	1	2
Crocodile	3	1	1
Komodo Dragon	2	3	2
Iguana	0	1	1
Greek tortoise	0	0	1
Dolphin	29	36	17
Gorilla	1	8	17
Chimpanzee	0	0	6
Orangutan	1	0	0
Siamang	0	0	8
Lar Gibbon	1	0	8
Baboon	0	2	0
Japanese Macaque	0	1	2
Spider Monkey	0	1	5
Lemur	1	1	1
Bear	1	2	0
Red Panda	2	4	4
Koala	13	16	14
Kangaroo	0	1	2
Tiger	15	23	9
White Tiger	5	10	31
Lion	18	34	22
Leopard	2	1	0
Cheetah	4	7	2
Jaguar	1	5	4
Iberian Lynx	3	8	10
Ocelot	0	1	1
Wolf	3	3	1
Zebra	3	8	3
Giraffe	6	11	15
Okapi	2	2	1
Elephant	5	2	3
Rhinoceros	4	2	0
Hippopotamus	0	3	4
American Bison	0	0	1
Buffalo	1	0	0
Black-faced Impala	0	0	1
Meerkat	1	4	21
Giant Anteater	1	0	0
Snakes	2	2	3
Lizards	1	0	0
Turtles	1	2	1
Reptiles	0	1	2
Monkeys	21	32	24
Primates	0	0	1
Total	200	300	300

Table A.3 – Frequency of all favourite species mentioned by 12-15 y.o. students in each treatment (control, pre- and post-program).

Favourite Species	Control	Pre	Post
DK/DR	32	29	16
Animals that do not exist at the zoo	14	8	1
Crocodile	2	0	0
Nile Crocodile	0	4	3
Komodo Dragon	0	3	3
Red-eared Slider	0	0	1
Burmese Python	0	0	1
Anaconda	0	1	0
Penguin	6	5	6
Pelican	0	0	1
Flamingo	0	3	3
Parrot	2	0	0
Dolphin	21	36	16
Gorilla	0	0	8
Chimpanzee	1	0	2
Orangutan	0	1	5
Lar Gibbon	0	0	3
Baboon	1	0	0
Japanese Macaque	0	0	2
Lemur	0	0	3
Ring-tailed Lemur	0	1	1
Bear	3	0	0
Red Panda	1	3	2
Koala	12	7	18
Kangaroo	0	0	1
Tiger	5	11	12
Sumatran Tiger	0	0	2
Amur Tiger	0	0	4
White Tiger	6	5	2
Lion	25	20	12
Leopard	0	1	0
Cheetah	2	0	2
Jaguar	2	3	1
Iberian Lynx	6	4	3
Wolf	2	3	1
Zebra	1	3	4
Giraffe	14	15	12
Okapi	2	1	3
Elephant	2	10	4
Rhinoceros	0	4	3
Camel	0	2	3
American Bison	0	0	1
Scimitar-horned Oryx	0	0	4
Meerkat	6	2	21
Giant Anteater	0	0	1
Snakes	3	2	1
Reptiles	0	0	1
Birds	1	3	1
Birds of prey	1	0	0
Primates	1	1	3
Monkeys	24	23	15
Felines	2	2	3

Mammals	0	1	2
Total	200	217	217

Table A.4 – Frequency of all favourite species mentioned by 15-18 y.o. students in each treatment (control, pre- and post-program).

Favourite Species	Control	Pre	Post
DK/DR	31	34	20
Animals that do not exist at the zoo	8	3	0
Bromelia	0	0	1
Tarantula	1	0	0
Axolotl	0	1	3
American Alligator	0	1	1
Komodo Dragon	0	1	0
Iguana	0	0	1
Leopard Tortoise	0	0	1
Roti Snake-necked Turtle	0	2	0
Penguin	6	15	9
Pelican	0	0	2
Flamingo	1	2	3
Owl	1	0	0
Hawk	0	1	0
Macaw	0	1	0
Blue-and-yellow Macaw	0	0	1
Hyacinth Macaw	0	0	2
Peacock	0	2	2
Dolphin	20	26	9
Gorilla	5	9	17
Chimpanzee	0	1	9
Orangutan	0	1	0
Siamang	0	0	1
Lar Gibbon	0	0	8
Baboon	0	3	3
Japanese Macaque	0	0	1
Spider Monkey	0	1	4
Lemur	1	0	2
Ring-Tailed Lemur	0	1	0
Golden-headed Lion Tamarin	0	1	1
Emperor Tamarin	0	0	1
Bear	2	6	2
Red Panda	3	4	10
Koala	9	19	20
Kangaroo	2	0	2
Tiger	12	18	15
Sumatran Tiger	0	1	1
Amur Tiger	0	3	10
White Tiger	7	8	41
Lion	23	16	9
Leopard	2	0	1
Cheetah	2	7	2
Jaguar	3	6	6
Iberian Lynx	4	7	3
Ocelot	0	2	0
Wolf	2	0	1
Zebra	5	2	0
Giraffe	11	23	14
Angolan Giraffe	0	0	1
Okapi	1	3	0
Elephant	3	4	0
Rhinoceros	3	3	4
White Rhinoceros	1	0	1

Greater One-horned Rhino	0	0	1
Hippopotamus	2	2	1

Table A.4 – (Continued)

Pygmy Hippopotamus	**0**	**1**	**0**
African Buffalo	0	1	1
Camel	1	0	1
Deer	0	1	0
Scimitar-horned Oryx	0	0	3
Meerkat	2	16	21
Giant Anteater	0	4	3
Racoon	0	0	1
Snakes	1	3	0
Turtles	2	1	0
Reptiles	0	3	0
Birds	0	1	2
Primates	1	3	5
Monkeys	22	21	12
Felines	0	5	3
Marsupials	0	0	1
Total	200	300	300

Table A.5 – Frequency of all threatened animals mentioned by 10-12 y.o. students in each treatment (control, pre- and post-program).

Threatened Animal	Control	Pre	Post
DK/DR	22	59	39
Non Threatened Animals	7	35	31
Atlantic Bluefin Tuna	0	2	0
Whale	0	1	0
Sperm Whale	0	2	0
Dolphin	1	4	2
Amazon River Dolphin	0	2	2
Penguin	4	0	3
Flamingo	1	0	0
Hyacinth Macaw	1	1	1
Hummingbird	0	0	2
Chinese Water Dragon	0	2	0
Axolotl	0	0	1
Gorilla	1	0	6
Orangutan	1	0	0
Siamang	0	0	3
Spider Monkey	0	0	1
Ring-tailed Lemur	0	1	0
Black Lemur	0	0	5
Polar Bear	4	4	5
Giant Panda	31	23	8
Red Panda	6	6	9
Koala	39	32	29
Tasmanian Devil	1	0	0
Snow Leopard	2	0	0
Tiger	4	13	12
Sumatran Tiger	0	0	1
Lion	3	5	6
Iberian Lynx	57	99	81
Iberian Wolf	1	0	3
European Rabbit	1	0	0
Zebra	1	4	0
Grevy´s Zebra	0	0	2
Giraffe	0	1	0
Okapi	1	0	0
Elephant	5	1	0
African Elephant	0	0	10
Rhinoceros	0	3	10
White Rhinoceros	2	0	0
Greater One-horned Rhino	0	0	4
Bison	1	0	0
Bongo	0	0	3
Scimitar-horned Oryx	0	0	21
Monkeys	1	0	0
Turtles	1	0	0
Bees	1	0	0

Total	200	300	300

Table A.6 - Frequency of all threatened animals mentioned by 12-15 y.o. students in each treatment (control, pre- and post-program).

Threatened Animal	Control	Pre	Post
DK/DR	40	38	24
Non Threatened Animals	5	18	8
White Shark	1	0	0
Whale	3	5	2
Sperm Whale	0	1	1
Dolphin	2	1	1
Penguin	1	0	0
Hyacinth Macaw	0	4	3
Bali Myna	0	0	6
Gorilla	1	0	1
Orangutan	0	1	0
Sumatran Orangutan	0	0	1
Ring-tailed Lemur	0	0	12
Bear	1	0	0
Polar Bear	9	5	5
Giant Panda	17	7	7
Red Panda	0	0	4
Koala	63	8	15
Kangaroo	1	0	0
Persian Leopard	0	0	1
Tiger	0	2	9
Bengal Tiger	0	0	1
South China Tiger	0	1	0
Lion	0	1	1
Iberian Lynx	40	95	65
Iberian Wolf	4	8	4
European Rabbit	0	0	1
Black-footed Ferret	1	0	0
Sloth	0	1	0
Zebra	0	2	1
Elephant	5	5	0
African Elephant	0	0	10
Rhinoceros	2	6	7
Scimitar-horned Oryx	0	0	26
Monkeys	1	0	0
Birds	1	0	0
Turtles	1	3	1
Bees	1	5	0
Total	200	217	217

Table A.7 - Frequency of all threatened animals mentioned by 15-18 y.o. students in each treatment (control, pre- and post-program).

Threatened Animal	Control	Pre	Post
DK/DR	28	20	17
Non Threatened Animals	7	20	28
Seahorse	0	1	0
Sardine	0	2	0
Whale	0	3	1
Dolphin	1	0	0
Penguin	0	1	4
Pelican	0	1	0
Hyacinth Macaw	0	2	2
Bali Myna	0	0	2
Northern Bald Ibis	0	0	3
Gorilla	0	0	1
Chimpanzee	0	0	1
Orangutan	0	1	0
Sumatran Orangutan	0	0	3
Spider Monkey	0	0	1
Golden Lion Tamarin	1	0	0
Golden-headed Lion Tamarin	0	0	1
Polar Bear	6	4	6
Giant Panda	10	28	11
Red Panda	0	3	2
Koala	90	123	103
Leopard	0	1	0
Snow Leopard	0	1	0
Persian Leopard	0	0	1
Tiger	1	11	15
Bengal Tiger	0	0	1
Sumatran Tiger	0	0	5
Amur Tiger	0	4	3
Lion	0	1	1
Iberian Lynx	46	54	43
Iberian Wolf	1	1	0
Okapi	0	1	0
Elephant	1	2	0
African Elephant	0	0	7
Rhinoceros	6	12	12
Greater One-horned Rhino	0	0	2
Bongo	0	0	2
Scimitar-horned Oryx	0	0	22
Turtles	0	3	0
Sea Turtles	1	0	0
Bees	1	0	0
Total	200	300	300

Table A.8 – Parameters of the GLM and GLMM models relating the effect of each treatment (control, pre- and post-program) on students´ emotional domain answers, including intercepts. Sample size differed between questions and age groups due to the exclusion of DK/DA answers from the analyses. Treatment was converted to a dummy variable using control as indicator in comparisons between control and pre-program and pre- in comparisons between pre- and post-program. Significance was set at 0.05 (in *), near-significance represented with ·. Questions accordingly to Table 1.1.

Emotional Domain							
Question	**Ages**	**Treatment**	**Estimate**	**St.Error**	**z-value**	**t-value**	**P-value**
Control vs. Pre							
Q.2	10-12	Pre	-0.207	0.206	-1.004		0.316
	12-15	Pre	-0.005	0.208	-0.026		0.979
	15-18	Pre	0.263	0.247	1.062		0.288
Q.3	10-12	(Intercept)	0.491	0.025		19.540	<0.001*
		Pre	-0.090	0.032		-2.790	0.005*
	12-15	(Intercept)	0.444	0.028		15.975	<0.001*
		Pre	-0.041	0.039		-1.061	0.289
	15-18	(Intercept)	0.471	0.027		17.216	<0.001*
		Pre	-0.030	0.035		-0.849	0.396
Pre vs Post							
Q.1	10-12	Post	0.562	0.182	3.086		0.002 *
	12-15	Post	0.341	0.204	1.672		0.095 ·
	15-18	Post	0.418	0.175	2.394		0.017*
Q.2	10-12	Post	0.361	0.188	1.920		0.055 ·
	12-15	Post	0.042	0.207	0.204		0.839
	15-18	Post	0.325	0.186	1.745		0.081 ·
Q.3	10-12	(Intercept)	0.401	0.021		18.893	<0.001*
		Post	0.245	0.030		8.148	<0.001*
	12-15	(Intercept)	0.403	0.027		14.711	<0.001*
		Post	0.254	0.038		6.603	<0.001*
	15-18	(Intercept)	0.441	0.022		19.777	<0.001*
		Post	0.274	0.032		8.685	<0.001*

Table A.9 - Parameters of the GLM and GLMM models relating the effect of each treatment (control, pre- and post-program) on students´ cognitive domain answers, including intercepts. Sample size differed between questions and age groups due to the exclusion of DK/DA answers from the analyses. Treatment was converted to a dummy variable using control as indicator in comparisons between control and pre-program and pre- in comparisons between pre- and post-program. Significance was set at 0.05 (in *). Questions accordingly to Table 1.1.

Cognitive Domain							
Question	**Ages**	**Treatment**	**Estimate**	**SE**	**z-value**	**t-value**	**P-value**
Control vs. Pre							
Q.5	10-12	(Intercept)	0.474	0.022		21.195	<0.001*
		Pre	0.072	0.029		2.449	0.015*
	12-15	(Intercept)	0.596	0.016		36.233	<0.001*
		Pre	-0.036	0.023		-1.544	0.123
	15-18	(Intercept)	0.541	0.033		16.657	<0.001*
		Pre	-0.017	0.041		-0.408	0.683
Q.6	10-12	(Intercept)	-0.987	0.229	-4.304		<0.001*
		Pre	0.446	0.280	1.595		0.111
	12-15	(Intercept)	0.581	0.581		24.410	<0.001*
		Pre	-0.206	0.034		-6.046	<0.001*
	15-18	(Intercept)	0.331	0.026		12.974	<0.001*
		Pre	<0.001	0.032		0.026	0.979
Q.7	10-12	(Intercept)	0.939	0.309	3.045		0.002*
		Pre	-0.423	0.314	-1.351		0.177
	12-15	(Intercept)	-1.149	0.429	-2.681		0.007*
		Pre	-0.116	0.376	-0.310		0.757
	15-18	(Intercept)	0.027	0.166	0.166		0.869
		Pre	0.229	0.210	1.091		0.275
Pre vs. Post							
Q.5	10-12	(Intercept)	0.402	0.019		21.139	<0.001*
		Post	0.113	0.026		4.313	<0.001*
	12-15	(Intercept)	0.561	0.016		35.778	<0.001*
		Post	0.055	0.022		2.504	0.013*
	15-18	(Intercept)	0.525	0.025		20.606	<0.001*
		Post	0.087	0.035		2.512	0.012*
Q.6	10-12	(Intercept)	-0.541	0.160	-3.380		<0.001*
		Post	0.894	0.176	5.074		<0.001*
	12-15	(Intercept)	0.375	0.027		14.037	<0.001*
		Post	0.107	0.036		2.961	0.003*
	15-18	(Intercept)	0.332	0.020		16.235	<0.001*
		Post	0.128	0.028		4.554	<0.001*
Q.7	10-12	(Intercept)	0.694	0.500	1.387		0.166
		Post	0.789	0.217	3.643		<0.001*
	12-15	(Intercept)	-1.186	0.476	-2.491		0.013*
		Post	-0.172	0.312	-0.550		0.582
	15-18	(Intercept)	-0.099	0.458	-0.215		0.830
		Post	0.258	0.192	1.346		0.178

Table A.10 - Parameters of the GLM and GLMM models relating the effect of each treatment (control, pre- and post-program) on students´ behavioural domain answers, including intercepts. Sample size differed between questions and age groups due to the exclusion of DK/DA answers from the analyses. Treatment was converted to a dummy variable using control as indicator in comparisons between control and pre-program and pre- in comparisons between pre- and post-program. Significance was set at 0.05 (in *), near-significance represented with · Questions accordingly to Table 1.1

Behavioural Domain							
Question	**Ages**	**Treatment**	**Estimate**	**SE**	**z-value**	**t-value**	**P-value**
Control vs. Pre							
		(Intercept)	0.053	0.04		13.351	0.028*
	10-12	Pre	-0.055	0.022		-2.433	0.025*
		(Intercept)	0.241	0.007		34.817	<0.001*
Q.8	12-15	Pre	0.002	0.01		0.196	0.845
		(Intercept)	0.158	0.014		11.28	<0.001*
	15-18	Pre	-0.006	0.018		0.018	0.737
	10-12	Pre	0.264	0.179	1.476		0.140
Q.9	12-15	Pre	0.153	0.185	0.828		0.408
	15-18	Pre	-0.093	0.170	-0.55		0.583
	10-12	(Intercept)	1.688	0.349	4.842		<0.001*
		Pre	-1.035	0.298	-3.469		<0.001*
Q.10.1	12-15	(Intercept)	1.237	0.169	7.304		<0.001*
		Pre	-0.181	0.23	-0.787		0.431
	15-18	(Intercept)	1.551	0.186	8.332		<0.001*
		Pre	0.321	0.252	1.275		0.202
	12-15	(Intercept)	1.269	0.218	5.823		<0.001*
		Pre	-0.254	0.307	-0.826		0.409
Q.10.2	15-18	(Intercept)	2.214	0.292	7.581		<0.001*
		Pre	-0.599	0.349	-1.717		0.086
	10-12	Pre	0.168	0.182	0.928		0.353
Q.11	12-15	Pre	0.033	0.191	0.174		0.862
	15-18	Pre	0.402	0.180	2.241		0.025*
	10-12	Pre	-0.047	0.195	-0.240		0.810
Q.12	12-15	Pre	0.098	0.199	0.491		0.623
	15-18	Pre	0.164	0.185	0.889		0.374
		(Intercept)	0.818	0.172	4.768		<0.001*
	10-12	Pre	0.095	0.234	0.405		0.685
		(Intercept)	0.835	0.445	1.877		0.061 ·
Q.13	12-15	Pre	0.003	0.525	0.006		0.995
		(Intercept)	1.972	0.267	7.392		<0.001*
	15-18	Pre	-0.175	0.33	-0.531		0.595
Pre vs. Post							
	10-12	(Intercept)	0.476	0.036		13.307	0.0146*
		Post	0.038	0.018		2.113	0.035*
Q.8	12-15	(Intercept)	0.243	0.006		40.536	<0.001*
		Post	0.015	0.009		1.763	0.079
	15-18	(Intercept)	0.148	0.018		8.229	0.047*
		Post	0.078	0.016		4.965	<0.001*
	10-12	Post	0.083	0.160	0.521		0.602
Q.9	12-15	Post	0.009	0.176	0.051		0.960
	15-18	Post	0.169	0.149	1.129		0.259
	10-12	(Intercept)	0.457	0.503	0.908		0.3639
		Post	0.409	0.19	2.156		0.031*
Q.10.1	12-15	(Intercept)	0.324	0.679	0.477		0.634

Table A.10 – (Continued)

		Post	0.727	0.255	2.855	0.004*
	15-18	(Intercept)	1.872	0.17	11.021	<0.001*
		Post	-0.137	0.235	-0.585	0.558
Q.10.2	12-15	(Intercept)	1.015	0.217	4.681	<0.001*
		Post	0.857	0.36	2.383	0.017*
	15-18	(Intercept)	1.616	0.191	8.476	<0.001*
		Post	0.63	0.313	2.015	0.044*
Q.11	10-12	Post	1.047	0.183	5.718	<0.001*
	12-15	Post	0.789	0.202	3.898	<0.001*
	15-18	Post	0.937	0.177	5.283	<0.001*
Q.12	10-12	Post	0.151	0.176	0.856	0.392
	12-15	Post	0.175	0.194	0.904	0.366
	15-18	Post	0.418	0.163	2.557	0.011*
Q.13	10-12	(Intercept)	0.913	0.16	5.717	<0.001*
		Post	-0.325	0.212	-1.533	0.125
	12-15	(Intercept)	1.005	0.183	5.505	<0.001*
		Post	0.992	0.305	3.252	0.001*
	15-18	(Intercept)	1.797	0.194	9.267	<0.001*
		Post	1.076	0.345	3.121	0.002*

Table A.11 - Parameters of the GLM and GLMM models relating the effect of each treatment (control, pre- and post-program) on the three domains considered, including intercepts. Sample size differed between domains and age groups due to the exclusion of DK/DA answers from the analyses. Treatment was converted to a dummy variable using control as indicator in comparisons between control and pre-program and pre- as indicator in comparisons between pre- and post-program. Significance was set at 0.05.

Domain	Ages	Treatment	Estimate	St.Error	t-value	P-value
Control vs. Pre						
	10-12	(Intercept)	<0.001	<0.001	28.601	<0.001*
		Pre	<0.001	<0.001	0.005	0.996
Emotional	12-15	(Intercept)	0.674	0.026	25.517	0.052 ·
		Pre	0.038	0.029	1.324	0.352
	15-18	(Intercept)	0.647	0.067	9.722	0.010*
		Pre	-0.046	0.022	-2.107	0.040*
	10-12	(Intercept)	0.365	0.034	10.609	0.001*
		Pre	0.085	0.029	2.884	0.006*
Cognitive	12-15	(Intercept)	0.383	0.0345	11.108	0.005*
		Pre	-0.081	0.038	-2.126	0.153
	15-18	(Intercept)	0.322	0.018	18.36	<0.001*
		Pre	-0.053	0.023	-2.330	0.020*
	10-12	(Intercept)	0.652	0.013	51.290	<0.001*
		Pre	0.105	0.016	6.410	<0.001*
Behavioural	12-15	(Intercept)	0.555	0.014	39.649	<0.001*
		Pre	-0.013	0.019	-0.654	0.513
	15-18	(Intercept)	0.546	0.041	13.314	0.003*
		Pre	0.002	0.020	0.111	0.912
Pre vs Post						
	10-12	(Intercept)	0.700	0.037	19.090	0.005*
		Post	0.120	0.015	7.924	<0.001*
Emotional	12-15	(Intercept)	0.71 0	0.015	48.085	<0.001*
		Post	0.091	0.021	4.358	<0.001*
	15-18	(Intercept)	0.736	0.022	33.508	<0.001*
		Post	0.110	0.013	8.262	<0.001*
	10-12	(Intercept)	0.331	0.082	4.020	0.052 ·
		Post	0.180	0.021	8.725	<0.001*
Cognitive	12-15	(Intercept)	0.294	0.012	24.377	<0.001*
		Post	0.073	0.017	4.276	<0.001*
	15-18	(Intercept)	0.322	0.018	18.36	<0.001*
		Post	0.129	0.020	6.343	<0.001*
	10-12	(Intercept)	0.547	0.011	51.609	<0.001*
		Post	0.098	0.015	6.531	<0.001*
Behavioural	12-15	(Intercept)	0.448	0.086	5.226	0.035*
		Post	0.063	0.018	3.392	<0.001*
	15-18	(Intercept)	0.335	0.042	7.993	<0.001*
		Post	0.129	0.020	6.343	<0.001*

Figure A.2.1 – Model questionnaire for 10-12 y.o. students (front).

2º Ciclo (Pré)

Nome: ____________________________

Distrito: ____________________________

Alguma vez tinhas estado no Jardim Zoológico de Lisboa?

☐ Sim ☐ Não sei ☐ Não

(Escolhe apenas uma hipótese em cada pergunta, a não ser que te seja dito o contrário)

1. Espero gostar da visita ao Jardim Zoológico:

Discordo completamente □

Discordo □

Não concordo nem discordo □

Concordo □

Concordo completamente □

Não sei/Não respondo □

2. Preocupas-te com o nosso planeta, animais e plantas que nele existem:

Discordo completamente □

Discordo □

Não concordo nem discordo □

Concordo □

Concordo completamente □

Não sei/Não respondo □

3. Para ti, os Zoos são para: (podes escolher <u>no máximo duas</u> opções)

Divertimento □

Aprender sobre animais □

Ver animais □

Salvar animais da extinção □

Ensinar os visitantes □

Relaxar □

Outras razões □

Não sei/Não respondo □

4. Qual é que achas que vai ser o teu animal preferido aqui no Jardim Zoológico? Porquê?

____

____

5. Escolhe as características que achas que os Répteis têm (podes escolher <u>no máximo três</u> opções):

Endotérmicos □

Têm escamas como revestimento □

Ovíparos □

Têm pele nua □

Vivíparos □

Ectotérmicos □

Todas as características acima □

Não sei/Não respondo □

6. Pensa no Pelicano-real, diz duas adaptações ou comportamentos que são importante para o seu tipo de vida, alimentação ou habitat?

____

____

____

Figure A.2.2 – Model questionnaire for 10-12 y.o. students (back).

7. Em relação ao tipo de locomoção, todas as Aves voam:

Discordo completamente □

Concordo completamente □

Não sei/Não respondo □

8. As plantas são importantes para o planeta porque: (podes escolher <u>no máximo três</u> opções)

Nos dão matérias-primas, como madeira □

Nos dão Oxigénio □

Nos dão sombra□

Servem de alimento para outros animais□

Capturam o Dióxido de Carbono□

Nos dão alimentos □

Todas as acima □

Não sei/Não respondo □

9. Diz o nome de um animal ameaçado/em perigo:

____

10. O Jardim Zoológico é importante para evitar a extinção dos animais ameaçados?

Discordo completamente □

Discordo □

Não concordo nem discordo □

Concordo □

Concordo completamente □

Não sei/Não respondo □

11. Para ti, é mais importante proteger primeiro os animais e só então as plantas do nosso planeta?

Discordo completamente □

Discordo □

Não concordo nem discordo □

Concordo □

Concordo completamente □

Não sei/Não respondo □

12. Há algo que tu podes fazer para ajudar a proteger o planeta e os animais ameaçados:

Discordo completamente □

Discordo □

Não concordo nem discordo □

Concordo □

Concordo completamente □

Não sei/Não respondo □

13. Se respondeste "Concordo" ou "Concordo completamente", diz algo que tu podes e vais fazer para ajudar a proteger o nosso planeta e animais ameaçados:

____

____

____

JARDIM ZOOLÓGICO

Figure A.3.1 – Model questionnaire for 12-15 y.o. students (front).

3º Ciclo (Pré)

Nome: ______________________________

Distrito: ______________________________

Alguma vez tinhas estado no Jardim Zoológico de Lisboa?

☐ Sim ☐ Não sei ☐ Não

(Escolhe apenas uma hipótese em cada pergunta, a não ser que te seja dito o contrário)

1. Espero gostar da visita ao Jardim Zoológico:

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

2. Preocupas-te com o nosso planeta, animais e plantas que nele existem:

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

3. Para ti, os Zoos são para: (podes escolher no máximo duas opções)

Divertimento ☐

Fazer investigação sobre as espécies ☐

Ver animais ☐

Conservar espécies ameaçadas de extinção ☐

Educar os visitantes acerca da conservação das espécies e natureza em geral ☐

Relaxar ☐

Outras razões ☐

Não sei/Não respondo ☐

4. Qual é que achas que vai ser a tua espécie preferida aqui no Jardim Zoológico? Porquê?

____

____

5. Seleciona todos os elementos que achas que fazem parte de um Ecossistema de Floresta Tropical (podes escolher no máximo três opções):

Pedras ☐

Jaguar ☐

Rio ☐

Temperatura☐

Lianas ☐

Fungos ☐

Todos os elementos acima ☐

Não sei/Não respondo ☐

Figure A.3.2 – Model questionnaire for 12-15 y.o. students (back).

6. Faz a ligação entre os seres vivos e relações bióticas que existem entre eles (faz apenas uma correspondência para cada):

Lince-ibérico – coelho-bravo	•	• Parasitismo
Líquenes	•	• Predação
Insetos – Plantas com flor	•	• Cooperação
Zebra-de-grevy – Carraças	•	• Mutualismo
Leão-africano – Leopardo-africano	•	• Competição
Grupo de Suricatas	•	• Simbiose

7. Numa teia trófica simples, composta por plantas (produtores), herbívoros (consumidores de primeira ordem) e carnívoros (consumidores de segunda ordem), se os carnívoros forem extintos o número de herbívoros continua sempre a aumentar:

Discordo completamente ☐

Concordo completamente ☐

Não sei/Não respondo ☐

8. Para ti, qual é a importância das plantas para o Homem e para o planeta em geral?

____

____

____

9. Diz o nome de uma espécie ameaçada. Porque é que está ameaçada?

____

____

10. Para ti, o Jardim Zoológico é importante para a conservação das espécies ameaçadas de extinção:

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

11. Para ti, devemos ter como prioridade a conservação das espécies animais e só depois conservar as espécies vegetais do nosso planeta?

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

12. Há algo que tu podes fazer para ajudar a conservar o planeta e espécies ameaçadas de extinção:

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

13. Se respondeste "Concordo" ou "Concordo completamente", diz algo que tu podes fazer para ajudar a conservar o nosso planeta e espécies ameaçadas de extinção:

____

____

____

JARDIM ZOOLÓGICO

Figure A.4.1 – Model questionnaire for 15-18 y.o. students (front).

Na Rota de Darwin (Pré)

Nome: ______________________________

Distrito: ______________________________

Alguma vez tinhas estado no Jardim Zoológico de Lisboa?

☐ Sim ☐ Não sei ☐ Não

(Escolhe apenas uma hipótese em cada pergunta, a não ser que te seja dito o contrário)

1. Espero gostar da visita do Jardim Zoológico

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

2. Preocupas-te com o nosso planeta, animais e plantas que nele existem:

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

3. Para ti, os Zoos são para: (podes escolher no máximo duas opções)

Divertimento ☐

Fazer investigação sobre as espécies ☐

Ver animais ☐

Conservar espécies ameaçadas de extinção ☐

Educar os visitantes acerca da conservação das espécies e natureza em geral ☐

Relaxar ☐

Outras razões ☐

Não sei/Não respondo ☐

4. Qual é que achas que vai ser a tua espécie preferida aqui no Jardim Zoológico? Porquê?

____

____

5. Segundo o Evolucionismo, as barbatanas dos Pinguins e as asas das Araras são um exemplo de: (podes selecionar no máximo três opções)

Evolução convergente ☐

Estruturas ancestrais ☐

Evolução divergente ☐

Estruturas homólogas☐

Seleção artificial ☐

Estruturas análogas ☐

Todos os elementos acima ☐

Não sei/Não respondo ☐

6. Geograficamente, como é que explicas que de um ancestral comum possam surgir tantas espécies diferentes?

____

____

____

Figure A.4.2 – Model questionnaire for 15-18 y.o. students (back).

7. Segundo a Teoria Darwinista, a Seleção Natural é o único vetor de evolução:

Discordo completamente ☐

Concordo completamente ☐

Não sei/Não respondo ☐

8. Para ti, qual é a importância da diversidade de plantas para o Homem e para o planeta em geral?

____

____

____

9. Diz o nome de uma espécie ameaçada. Porque é que está ameaçada?

____

____

10. Para ti, o Jardim Zoológico é importante para a conservação das espécies ameaçadas de extinção:

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

11. Para ti, devemos ter como prioridade a conservação das espécies animais e só depois conservar as espécies vegetais do nosso planeta?

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

12. Há algo que tu podes fazer para ajudar a conservar o planeta e espécies ameaçadas de extinção:

Discordo completamente ☐

Discordo ☐

Não concordo nem discordo ☐

Concordo ☐

Concordo completamente ☐

Não sei/Não respondo ☐

13. Se respondeste "Concordo" ou "Concordo completamente", diz algo que tu podes fazer para ajudar a conservar o nosso planeta e espécies ameaçadas de extinção:

____

____

____

JARDIM ZOOLÓGICO